(12)

US Army Corps
of Engineers

The Hydrologic
Engineering Center

GENERALIZED COMPUTER PROGRAM

AGDAM

(Agricultural Flood Damage Analysis)

Users Manual

(PROVISIONAL)

April 1985

AGRICULTURAL FLOOD DAMAGE ANALYSIS

(AGDAM)

COMPUTER PROGRAM

USER'S MANUAL

April 1985

THE HYDROLOGIC ENGINEERING CENTER
WATER RESOURCES SUPPORT CENTER
U.S. ARMY CORPS OF ENGINEERS
609 SECOND STREET
DAVIS, CALIFORNIA 95616

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose and Background	1
	1.2 Job-Size Limitations	1
	1.3 Hardware and Software Requirements	2
2.0	OVERVIEW OF AGDAM PROGRAM	3
	2.1 General	3
	2.2 Program Input and Output	3
	2.3 Data Processing Procedures	5
3.0	AGRICULTURAL FLOOD DAMAGE CONCEPTS	8
	3.1 Overview	8
	3.2 Crop Loss (Damage) Functions	9
	3.2.1 General	9
	3.2.2 Initial Preparation to End-of-Cultivation	9
	3.2.3 End-of-Cultivation to Crop Maturity Period	11
	3.2.4 Crop Maturity to End of Harvest Period	12
	3.3 Flood Characteristics Affecting Crop Damage	12
	3.3.1 Duration	12
	3.3.2 Flood Depth	13
	3.3.3 Sediment, Erosion, and Velocity	13
	3.4 Double Cropping	13
	3.5 Multiple Flood Concepts	13
	3.6 Infrastrucutre Damage	14
4.0	CONCEPTS AND COMPUTATION PROCEDURES	14
	4.1 Overview	14
	4.2 Crop Data	15
	4.2.1 General	15
	4.2.2 Crop Values	15
	4.2.3 Crop Loss Function	16
	4.2.4 Duration Loss Adjustment	16
	4.3 Season Concepts	19
	4.3.1 General	19
	4.3.2 Event Frequency	19
	4.3.3 Event-Season Weightings	19

perform 50

A-1

TABLE OF CONTENTS (Continued)

		Page
4.4	Damage Reach Data	21
	4.4.1 General	21
	4.4.2 Damage Reach Delineation	21
	4.4.3 Damage Reach Index Locations	21
	4.4.4 Discharge-Elevation (Rating Curve) Functions	23
	4.4.5 Crop Distribution Patterns	23
	4.4.6 Double Crop Specifications	26
	4.4.7 Hydrograph Data Requirements	26
4.5	Flood Damage Analysis Procedures	31
5.0	INPUT PREPARATION	34
5.1	General Description	34
5.2	Program Data Hierarchy	34
5.3	Input Data Descriptions	37
	5.3.1 Title Cards	37
	5.3.2 Job Specifications Card	37
	5.3.3 Crop Cards	37
	5.3.4 Season Cards	38
	5.3.5 Event Frequency Cards	38
	5.3.6 Damage Reach Cards	39
	5.3.7 Hydrologic Data Cards	40
	5.3.8 End-of-Job Card	41
6.0	OUTPUT DISPLAY	41
6.1	General	41
6.2	Description of Example Output	41
	6.2.1 Input Listing	41
	6.2.2 Title	41
	6.2.3 Job Card	41
	6.2.4 Crop Input Data	41
	6.2.5 Event Weightings by Seasons	42
	6.2.6 Damage Reach Specifications	42
	6.2.7 Rating Curve Data	42
	6.2.8 Flood Zone Data Summary	42
	6.2.8 Input Exceedance Frequency Hydrographs	42
	6.2.10 Interpolated Seasonal Hydrographs	42
	6.2.11 Zone Damage Summary	42
	6.2.12 Event Damage and Area Flooded Summary	42
	6.2.13 Reach Damage and Area Flooded Summaries	43
	6.2.14 Job Damage and Area Flooded Summaries	43
7.0	TEST PROBLEMS	43

APPENDICES

A. REFERENCES
B. GLOSSARY OF INPUT DATA VARIABLES
C. OUTPUT DISPLAYS
D. DATA INPUT FROM DSS
E. TEST PROBLEMS

Exhibit E-1: Manual Computation Example; Single Crop, Four Seasons, One Reach
Exhibit E-2: Single Crop, Four Seasons, One Reach Analysis Using AGDAM
Exhibit E-3: Multiple Crop and Reach Analysis Using AGDAM
Exhibit E-4: AGDAM Program Analysis Interface With DSS Data Input

F. PROGRAM INPUT DESCRIPTION

TABLES

		Page
1.1	INPUT DATA LIMITATIONS PER EXECUTION	2
4.1	EXAMPLE CROP DATA	16
4.2	JULIAN DAYS OF YEAR	17
4.3	EXAMPLE EVENT-SEASON WEIGHTINGS	21
5.1	PROGRAM DATA HIERARCHY	36
E1.1	ELEVATION-AGRICULTURAL AREA RELATIONSHIPS	E-7
E1.2	CROP DATA	E-7
E1.3	CROP LOSS PER ACRE (PERCENT LOSS VALUES)	E-9
E1.4	CROP LOSS PER ACRE (DOLLAR LOSS VALUES)	E-9
E1.5	PROPORTION OF TIME EVENT OCCURS BY SEASONS	E-10
E1.6	RATING CURVE	E-10
E1.7	DISCHARGE HYDROGRAPHS	E-11
E1.8	20% EXCEEDANCE EVENT ELEVATION HYDROGRAPH	E-12
E1.9	FLOOD ZONES: 20% CHANCE EXCEEDANCE EVENT	E-13
E1.10	20% CHANCE EXCEEDANCE EVENT DAMAGE TO CORN CALCULATION SUMMARY	E-17

FIGURES

2.1	AGDAM DATA INPUT AND OUTPUT	4
2.2	DATA STORAGE SYSTEM PROCESSING SCHEMATIC	6
3.1	CROP LOSS FUNCTION	10
4.1	CROP AND DURATION FLOODING LOSS FUNCTIONS	18
4.2	SEASON ANALYSIS CONCEPTS	20
4.3	DAMAGE REACH CONCEPT	22
4.4	DISCHARGE-ELEVATION (RATING CURVE) FUNCTIONS	24
4.5	TOTAL CROP ELEVATION-AREA RELATIONSHIP	25
4.6	INDIVIDUAL CROP ELEVATION-AREA RELATIONSHIP	25
4.7	DOUBLE CROPPING CONCEPTS	27
4.8	BALANCED FREQUENCY HYDROGRAPH CONCEPTS	28
4.9	HYDROGRAPH INTERPOLATION CONCEPTS	30
4.10	FLOOD ZONE DETERMINATION PROCEDURES	32

FIGURES (CONTINUED)

		Page
4.11	DURATION OF FLOODING BY ZONES	33
4.12	EXPECTED ANNUAL DAMAGE AND FLOODED AREA ANALYSIS	35
D.1	PATH NAME HIERARCHY CONCEPTS	D-3
E1.1	SMITH RIVER BASIN	E-6
E1.2	CROP LOSS FUNCTION	E-8
E1.3	ELEVATION HYDROGRAPH	E-14

AGRICULTURAL FLOOD DAMAGE ANALYSIS PROGRAM
USER'S MANUAL

1. INTRODUCTION

1.1 Purpose and Background

The Agricultural Flood Damage Analysis (AGDAM) computer program is designed to evaluate the agricultural flood damage potential of flood-plain areas. The primary purpose of the program is to calculate expected annual damage and area flooded by crop category and damage reach. Calculations are based on the crop loss potential throughout the year, crop distribution patterns, and weighted seasonal frequency flood events.

An overview of the flood damage evaluation concepts, requirements, and capabilities of the AGDAM program is presented herein. Input requirements and related output are described in detail. Sample input and output are included to demonstrate the capabilities of the program and to assist users in its application.

The AGDAM program is maintained and distributed by the Hydrologic Engineering Center, Water Resources Support Center, 609 Second Street, Davis, California 95616. The program is a product of the Corps Research and Development program. It was developed for the Detroit District Corps of Engineers. The District shared in funding the development cost. The Hydrologic Engineering Center should be contacted for questions regarding its use or availability.

1.2 Job-Size Limitations

Input requirements for the AGDAM program are designed to enable users considerable flexibility in specifying the level-of-detail of the analysis.

An unlimited number of damage reaches may be analyzed in a single program execution, although discretion by the user is recommended to minimize computer execution time and costs. Table 1.1 lists the maximum number of input values associated with commonly used variables.

TABLE 1.1

INPUT DATA LIMITATIONS PER EXECUTION

Input	Data Card	Maximum Number
Damage Reaches	DR	unlimited
Crop Categories (By Reaches)	CP	18
Crop Budget Dates	CT	30
Crop Loss-Duration Values	CD, C1-C6	6
Seasons	SN, SD	12
Exceedence Frequency Events	FT, FR	9
Rating Curve Values	EV, QQ	18
Double Crops/Reach	CP	10
Input Hydrographs/Reach/Season	QD, HQ, HF	9
Hydrograph Ordinates	H1-H9	150

1.3 Hardware and Software Requirements

The AGDAM program was developed using the Harris 500 minicomputer located at the Hydrologic Engineering Center. It is also maintained on the Corps of Engineers National Teleprocessing Services Program, currently the Control Data Corporation's Cybernet system located in Rockville, Maryland. The program is written to be highly transportable and should be readily adaptable to any computer with sufficient computing capabilities and a FORTRAN 77 compiler. Difficulties in installation should be reported to the Hydrologic Engineering Center.

General Program Characteristics:

Language - FORTRAN V ANSI x 3.9 - 1978
Memory - 200,000 (Octal) Harris 500'
Special Library
Routines - ASGN (* HECLIB)

Files:

Unit 5 - Normal input, 80 character format
Unit 6 - Normal printer output, 133 character format
Unit 10 - Optional file used between program executions - unformatted
Unit 11 - scratch file 80 character format

2.0 OVERVIEW OF AGDAM PROGRAM

2.1 General

The Agricultural Flood Damage Analysis (AGDAM) program enables users to define input parameters for the level of detail commensurate with the available data and study requirements. The program is applicable for studies where: (1) formulation of numerous alternatives, damage reaches, and damage categories is required; (2) consistency is desired in analytical techniques involving mixes of structural and agricultural damage categories; and (3) detailed and reliable historic record of continuous hydrologic data for ungaged locations cannot be generated within study constraints. Where enhanced level of detail of analysis is required and the data permits, other procedures, such as a period-of-record evaluation, may be applied (Vicksburg District Corps of Engineers 1979).

2.2 Program Input and Output

The principal input and output of the AGDAM program are depicted in Figure 2.1. Job specifications define the input and output requirements and

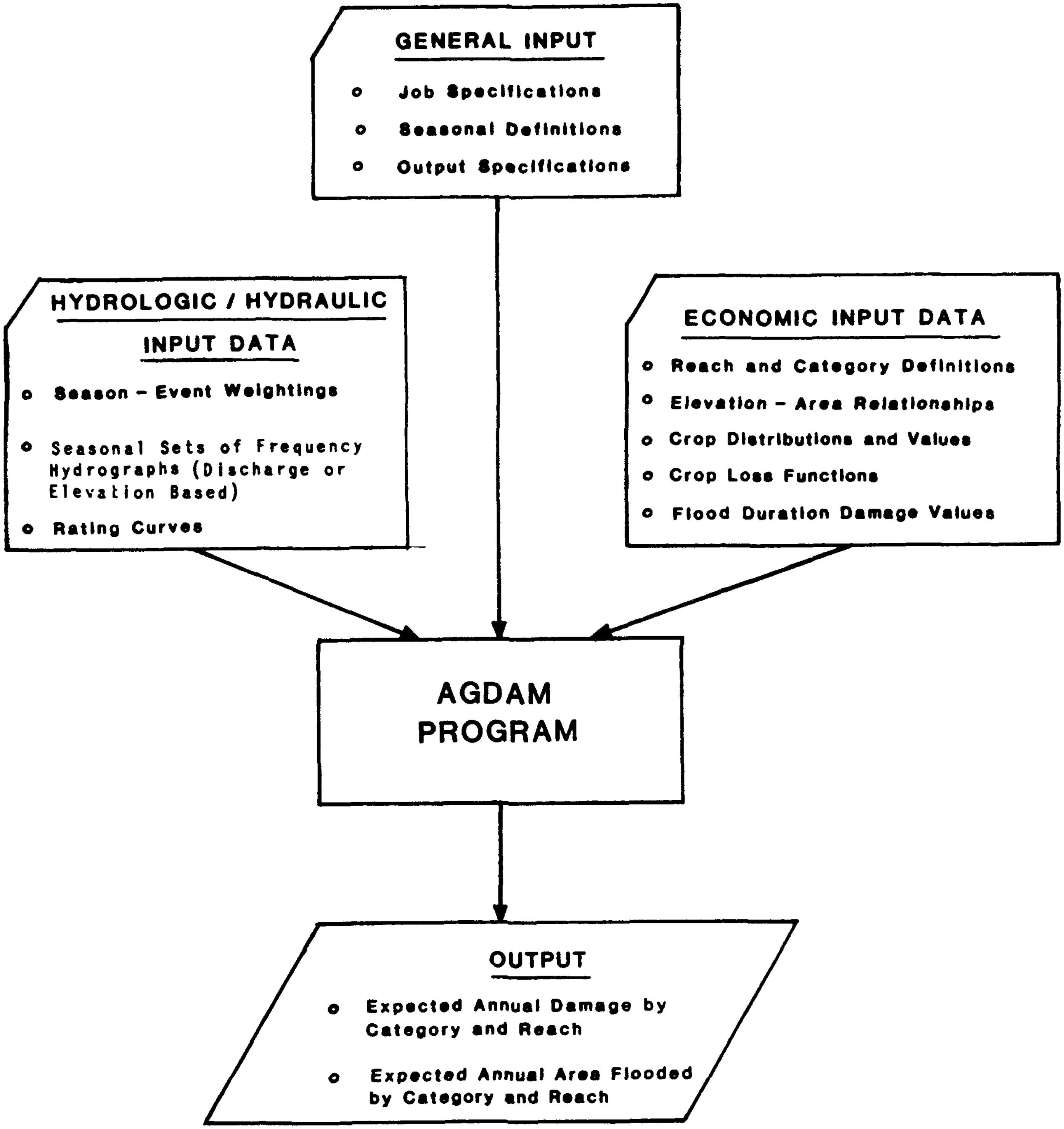


Figure 2.1 AGDAM INPUT AND OUTPUT SCHEMATIC

the analysis parameters to be performed. Crop data, which define crop values and loss functions (loss potential throughout the year), are typically constant over time for a region or Corps District. Therefore, they may be developed and used for several studies by storing and retrieving data through a data file.

Seasonal data define periods of the year where damage potential is calculated and weighted based on the proportion of time flood events occur during each season. Damage reach information includes definition of reach crop categories distribution patterns. Hydrologic input data are seasonal sets of frequency hydrographs with ordinates input as elevation (stage) or discharge values.

The primary outputs from the AGDAM program are expected annual damage and area flooded by crop category and damage reach. Calculated event damage and area flooded are also output. The output may be placed on a computer data storage device and/or obtained as paper printout.

2.3 Data Processing Procedures

The AGDAM program is designed to function as a stand-alone program or to interface with the Data Storage System (DSS) developed by the Hydrologic Engineering Center (Eichert and Pabst 1982). AGDAM may also interface with Spatial Analysis Methods (SAM) geographic information systems (Hydrologic Engineering Center 1975 and Davis 1978).

A schematic of the interfacing concepts of the AGDAM program with the grid cell data bank (SAM) computer programs, and DSS, is shown in Figure 2.2. This process automates, to a large extent, information transfers between analytical programs used to perform comprehensive planning investigations. Similar data may be input directly into the program.

The HEC-1 program retrieves runoff parameters from the DSS (step 1 of Figure 2.2) and generates seasonal sets (if necessary) of flood exceedance frequency hydrographs at designated damage reach index locations. The normal depth rating curve option of HEC-1 may be used to generate elevation-based

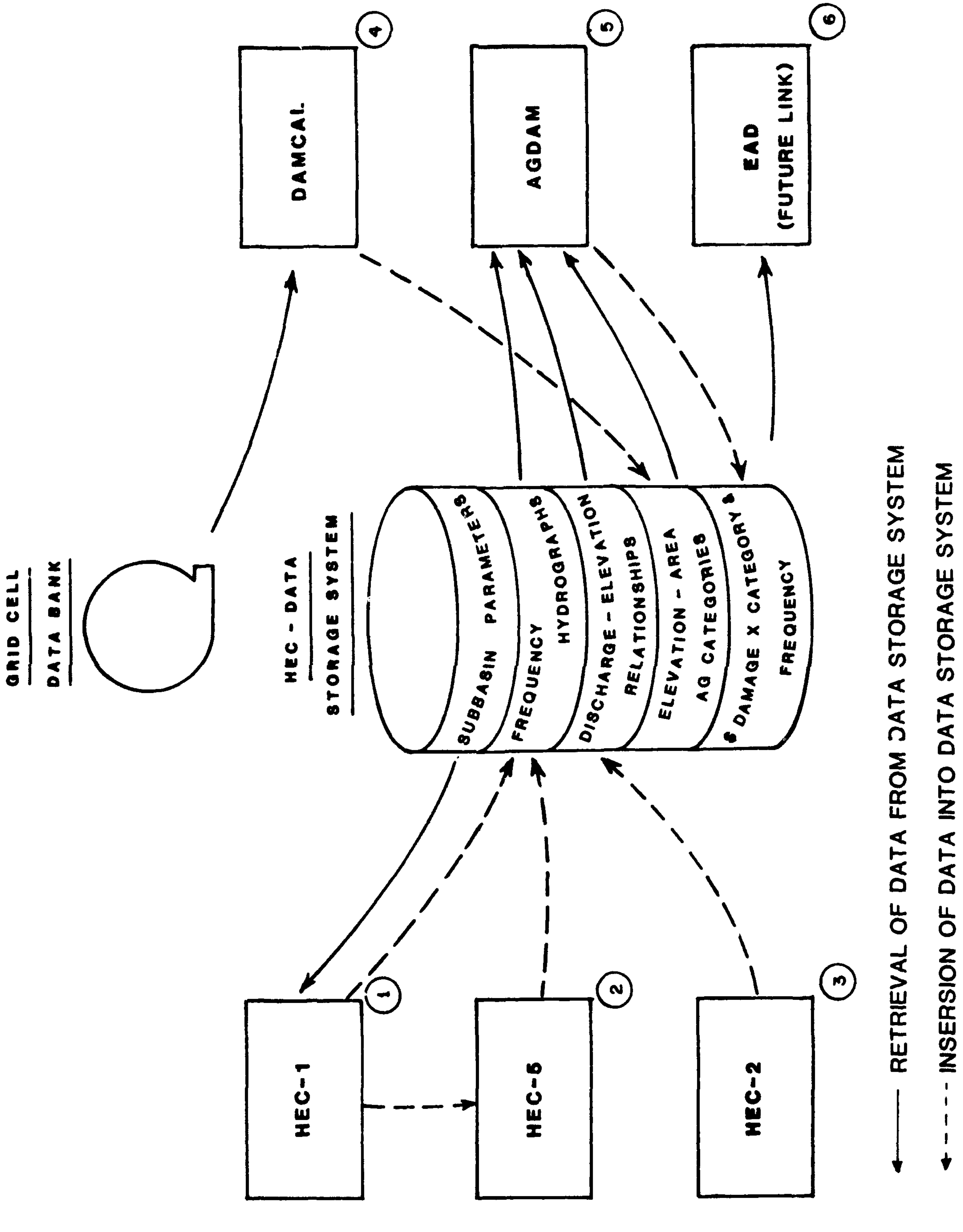


Figure 2.2 AGDAM DATA STORAGE PROCESSING SCHEMATIC

hydrographs at damage reach index locations where detailed water surface profile data are not available. The properly labeled discharge- (or elevation-) hydrographs are subsequently stored in the *DSS*.

The HEC-5 computer program (step 2 of Figure 2.2) routes flood hydrographs through single or multiple reservoir systems with complex controlled operation requirements. Output may be discharge or elevation hydrographs at desired locations. The HEC-5 input hydrographs may be generated by the HEC-1 program and transferred by data file or, more normally, via the DSS (not shown for clarity). The HEC-5 calculated hydrographs are placed in the DSS for subsequent retrieval by the AGDAM program.

The HEC-2 computer program (step 3) calculates water surface profiles for user specified reaches. The profiles provide discharge-elevation relationships (rating curves) at damage reach index locations. These relationships are inserted into the DSS for applications by other programs.

The DAMCAL program (step 4) develops elevation-agricultural area (in acres) at damage reach index locations. The relationships are generated by reference flood elevations (Hydrologic Engineering Center 1975 and 1978) to account for slope in water surface profiles. The DAMCAL generated elevation-area values are stored in the DSS.

The AGDAM program (step 5 of Figure 2.2) retrieves discharge (or elevation) frequency hydrographs, rating functions, and elevation - agricultural area relationships from the DSS. Crop loss functions may be retrieved from a data file outside of the DSS (step 6). The program calculates expected annual damage and area flooded by crop category and damage reach.

Future DSS linkage of the AGDAM results (step 6 of Figure 2.2) to the Expected Annual Damage Computation program (Hydrologic Engineering Center 1977) calculations will enable equivalent annual agricultural damage and damage reach displays along with that of urban structural damage.

The user may elect to use all, a portion, or none of the data storage and transfer processing capabilities. Therefore, AGDAM input data may be input by retrieval of data from the DSS, and via normal card image format.

3.0 AGRICULTURAL FLOOD DAMAGE CONCEPTS

3.1 Overview

Flood damage to agricultural crops is the economic opportunity lost due to a flood event. Damage potential is estimated to be composed of the following components:

- The investment cost (IC) related to bringing the crop to market;
- Net revenue (NR), defined as income minus costs after harvesting mature crops; plus,
- Damage to the crop, related land, or infrastructures (OC) (tile drains, ditches, farm roads, out-structures, culverts, etc.) as *determined by the cost of correcting the damage.*

An equation may therefore be developed that specifies the agricultural damage (D) associated with a given crop as:

$$D_{ij} = IC_{ti} + NR_{i} + OC_{ij} \qquad \text{(Equation 3.1)}$$

where: i = specified crop
t = flood date
j = event

and D, IC, NR, OC are as defined above.

Damage from a previous flood may be reduced by the net revenue of any crop replanted and harvested subsequent to that flood. Damage is increased if the replanted crop results in a net loss rather than new gain (Carson 1983). Replant considerations are discussed in Section 3.5 under Multiflood Concepts.

3.2 Crop Loss (Damage) Functions

3.2.1 General. Flood damage to agricultural crop areas is dependent on the type of crop, time-of-year, and physical characteristics of the flood event. The loss potential of a specific crop varies throughout the year from initial soil preparation for planting to completion of harvest. If the related agricultural infrastructure damage is considered separately or as a precentage of the damage to the crop, the direct crop damage (using Equation 3.1) becomes:

$$D_{ij} = IC_{ti} + NR_{i} \qquad \text{(Equation 3.2)}$$

where:

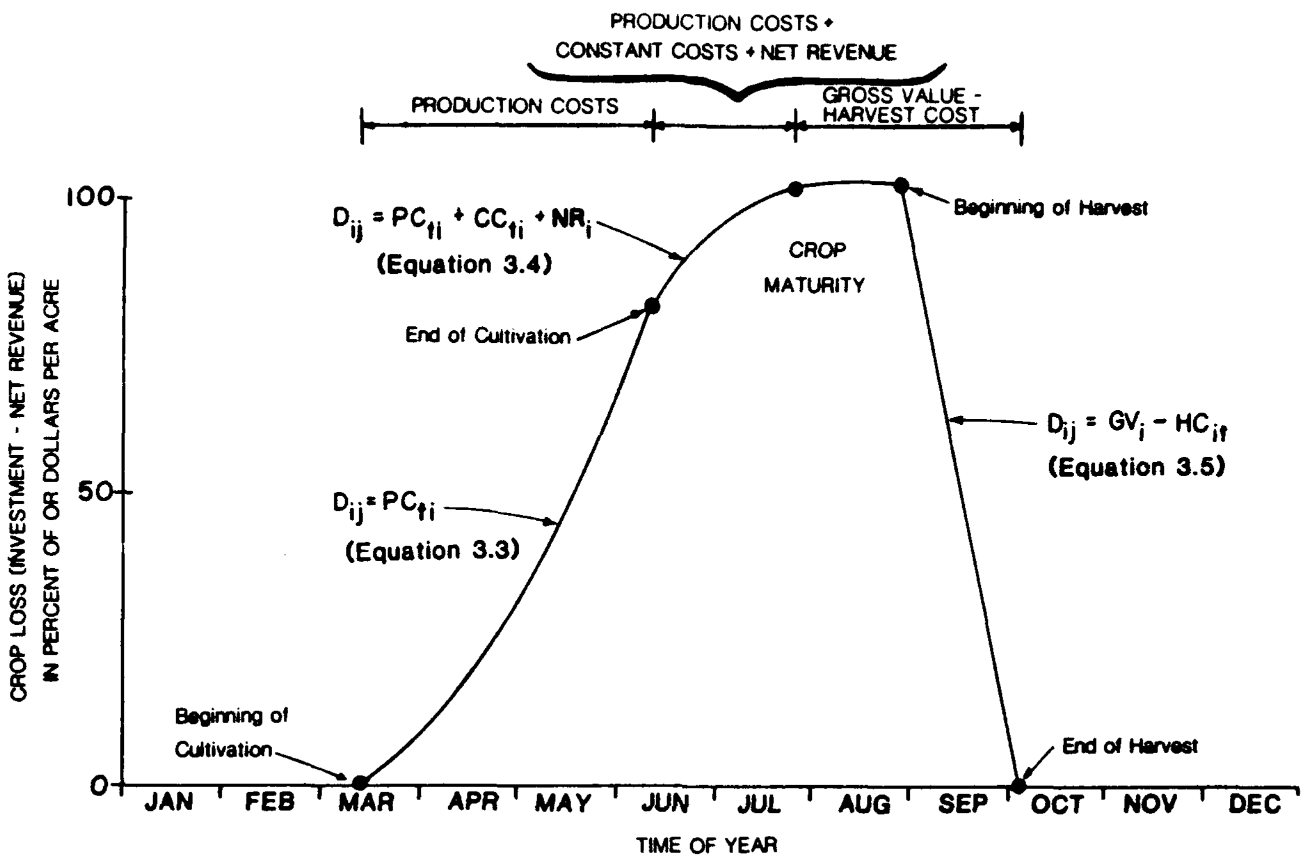
D_{ij} = Direct damage to crop (i) for event (j);

IC_{ti} = Investment costs at time-of-year (t) for crop (i); and

NR_{i} = Net Revenue for crop (i).

Crop loss functions are commonly used to define variations in the damage potential of a crop throughout the year. The functions depict a continuous relationship of day-of-year versus the potential investment and net revenue (profit) associated with the crop. The functions may be developed as dollar or percentage of the gross value (price times yield at maturity) of the crop minus the harvest cost. Figure 3.1 illustrates a crop loss function. The development of crop loss functions are conceptualized in the subsequent paragraphs.

3.2.2 Initial Preparation to End-of-Cultivation. The direct crop damage associated with the initial preparation to end-of-cultivation portion of the crop loss function is loss of investments in production costs (PC). Production costs include: cultivation, seed, fertilizer, herbicides, pesticides, machinery, and labor. Replant often occurs during this period after a flood event without a reduction in yield or loss of net revenue (profit). Therefore, Equation 3.2 may be simplified as:



D_{ij}	=	Direct damage to crop (i) for event (j)
PC_{ti}	=	Production Costs at time (t) for crop (i)
CC_{ti}	=	Constant Costs at time (t) for crop (i)
NR_i	=	Net Revenue for crop (i)
GV_i	=	Gross Value of crop (i) at maturity
HC_{it}	=	Harvest Cost of crop (i)at time (t)

FIGURE 3.1 CROP LOSS FUNCTION

$$D_{ij} = IC_{ti}, \text{ or}$$

$$D_{ij} = PC_{ti} \qquad \text{Equation (3.3)}$$

where:

D_{ij} = Direct damage to crop (i) for event (j)

IC_{ti} = Investment cost at time-of-year (t) for crop (i); and

PC_{ti} = Production costs at time-of-year (t) for crop (i)

3.2.3 End-of-Cultivation to Crop Maturity Period. Crop damage from flood events occurring between the end-of-cultivation and the time the crop reaches maturity includes: investment losses (IC) or production costs (OC); constant costs (CC) (insurance overhead, harvest equipment); and net revenue (NR). Replanting the same crop during this period is often not economically feasible. Therefore the damage relationship defined by Equation 3.2 for this period is commonly developed as:

$$D_{ij} = IC_{ti} + NRi$$

where: $IC_{ti} = PC_{ti} + CC_{ti}$

therefore: $D_{ij} = PC_{ti} + CC_{ti} + NR_i$ (Equation 3.4)

and, D_{ij} = Direct damage to crop (i) for event (j);

IC_{ti} = Investment cost at time-of-year (t) for crop (i);

PC_{ti} = Production costs at time-of-year (t) for crop (i); and

NR_i = Net revenue (profit) for crop (i)

3.2.4 Crop Maturity to End of Harvest Period. The damage potential of a crop area is greatest when the crop reaches maturity and before the start of harvest. The gross value of the crop is equal to the price per unit times the yield in units per area. Gross value may also be expressed as the total investment cost plus net revenue.

The damage potential of a crop area from the time of crop maturity to end of harvest may be expressed as:

$$D_{ij} = (GV_i - HC_i)\ (PCTSTD)_i \qquad \text{(Equation 3.5)}$$

where:

D_{ij} = Direct damage to crop (i) for event (j);

GV_i = Gross value per acre of crop (i);

HC_i = Harvest cost per acre of crop (i); and

(PCTSTD) = Percent crop (i) standing (not harvested) at time of flood event (j).

3.3 Flood Characteristics Affecting Crop Damage.

Flood characteristics affect the proportion of crop damaged. Key characteristics are: duration and depth of flooding; sediment deposits; erosion; and velocity.

3.3.1 Duration. Duration is a critical parameter in the determination of flood damage to crops. The impact of duration of flood typically varies throughout the cultivation, growing, and harvest periods. A few days of flooding in the initial phase of plant development may not result in damage (loss of production costs), while a few hours of inundation at crop maturity may result in total loss.

3.3.2 Flood Depth. Depth of flooding on a standing crop impacts the yield. It is generally considered a primary factor in causing crop losses during harvest periods. Crop losses related to depth occur primarily through (1) loss of a portion of the crop that is inundated, (2) lack of oxygen to the root system, (3) reductions in product quality and market value of the crop. The impact of depth of flooding is based on the height of the plant during the cropping cycle and distribution of the harvestable product on the plant (as related to the height of the plant).

3.3.3 Sediment, Erosion, and Velocity. Sediment deposition, erosion, and velocity may or may not significantly impact crops. Again, much is dependent on the time-of-year and nature of flooding. Erosion, sediment, and velocity effects on damage are difficult to distinguish from depth and duration. The need to consider erosion and sedimentation impacts is greatest for alluvial streams.

3.4 Double Cropping

Planting and harvesting of two crops in the same field during a period of a year is called double cropping. Planting and harvesting of winter wheat followed by soybeans is an example of double cropping. Climate is the primary factor in being able to double crop an area.

3.5 Multiple Flood Concepts

The damage associated with a flood event may be influenced by previous events. The impact is dependent on the type of crop and the respective magnitudes, duration, and time-of-the-year of the events. The loss (or damage) is based on the capability of the farmer to replant following a flood.

Replanting costs represent investments made after a flood event to produce a subsequent crop. Seasonal factors and replant requirements resulting from a previous event can cause a reduction in replant area and crop yield. The reduction in revenue due to reduction in area replanted, direct yields or change in crops is an increment of damage to the previous event. The dryout period, the time required for the soil to sufficiently dry out so replant activities can begin, is critical to replant.

3.6 Infrastructure Damage

Infrastructure damage includes damage to items associated with commercial agriculture that are of a non-crop nature. Damage to farm roads, drainage and irrigation systems (both above and below ground), bridges and culverts, machinery and equipment, and out-structures necessary to produce and market crops may be included as infrastructure damage. This damage may represent a significant portion of the overall damage potential of an agricultural business.

4.0 CONCEPTS AND COMPUTATION PROCEDURES

4.1 Overview

The Agricultural Flood Damage Analysis computer program calculates expected annual damage and area flooded by crop category and damage reach. Computational procedures described address the crop loss, hydrologic data requirements for analysis, and the analytical procedures used to obtain the results.

Damage or area flooded analyses are performed using weighted seasonal frequency flood events. Crop loss functions, input for the job, are specified for the reach based on the type of crops normally planted within the reach. The damage assessment for each crop is performed based on the type of crop, cropping patterns (area-elevation relationships), and the magnitude, duration, and seasonal characteristics of a series of hypothetical frequency flood events. Damage values are calculated on a seasonal basis. Damage associated with each event and crop is therefore determined by summing the seasonally weighted (proportion of time the event occurs in each season) damage values. Expected annual damage values are subsequently calculated based on the annual frequency-damage relationships developed for each crop. Adjustments to the damage may be made for multiple flood (replant) considerations and infrastructure damage potential. Expected annual area flooded is calculated in a similar manner using area instead of damage.

4.2 Crop Data

4.2.1 General. Crop data define the value and damage potential of a particular crop throughout the year. Crop data used by the AGDAM program are specified for the job by a series of CR, CT, CB, CD, and C1-C6 cards for each crop. These data include: crop type, unit price, yield, definition of a crop loss function, and duration-of-flooding effects on the damage potential of each crop. Crop data are generally developed for a region (Corps District) and placed on a computer data file for use on subsequent investigations.

4.2.2 Crop Values. Crop values are input on CR cards. They include the crop yield per unit area (acre) and the price per unit (bushel, ton, etc.) value of the crop. The value of the crop per acre is determined by multiplying yield times the value per acre. These values are applied to the crop loss function (input as percent loss versus Julian day-of-the-year) to produce an actual damage versus day-of-the-year crop loss relationship. Other crop data on the CR card includes the Julian day-of-the-year associated with the end-of-cultivation, crop maturity, and beginning of harvest. These values are for information purposes only and are not used in damage calculations. Table 4.1 depicts the general crop data input on CR cards.

TABLE 4.1

EXAMPLE CROP DATA

CROP (CR.2)	YIELD/ACRE (CR.3)	UNITS (CR.4)	PRICE/UNIT (CR.5)	GROSS VALUE/ACRE (Calculated)	HARVEST COST/ACRE (CR.10)	MAX DOLLAR DAMAGE/ACRE (Calculated)
Corn	40	bushels	$ 4.00	$160.00	$30.00	$130.00
Soybeans	25	bushels	5.00	125.00	15.00	110.00
Wheat	42	bushels	3.50	147.00	25.00	122.00

4.2.3 Crop Loss Function. Crop loss functions (described in Section 3) are used to define potential crop damage values in the AGDAM program. The functions are defined as percent loss versus time-of-year for each crop. They are developed from investment and net revenue equations based on production costs, constant costs, harvest cost, and the value of the crop at maturity. The crop maturity period represents the greatest (100 percent) loss (damage) potential, which is equal to the gross value of the crop less harvest costs. The potential loss subsequently decreases, once harvest begins, through the completion of harvest (zero loss potential). Figure 3.1 depicts a generalized crop loss function and shows the equations used in defining the dollar loss function.

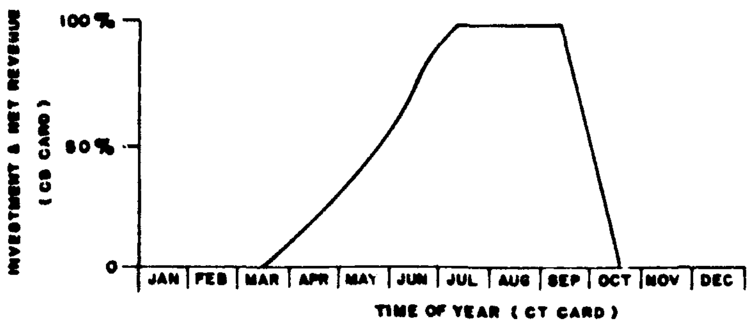
Crop loss functions are input on CT and CR cards. The CT cards specify Julian calendar days as shown in Table 4.2. Leap years are not considered. The CB card provides the associated percent loss values. A maximum of 30 values may be input. The program uses linear interpolation between input data points. The user must therefore be careful to define adequately the crop loss function.

4.2.4 *Duration Loss Adjustments*. The AGDAM program calculates the percent of the crop damaged per acre by duration of flood inundation. A generalized duration-percent crop loss relationship is shown in Figure 4.1.b. The relationships are input on CD and C1-C6 cards. The figure illustrates the input of four (0-, 1-, 3-, and 14-day) duration relationships to the estimated percent of crop that would be lost for that duration of flooding. A maximum of six duration relationships may be input in the AGDAM program. The careful definition of the duration adjustment relationships is important because intermediate values are linearly interpolated by the program.

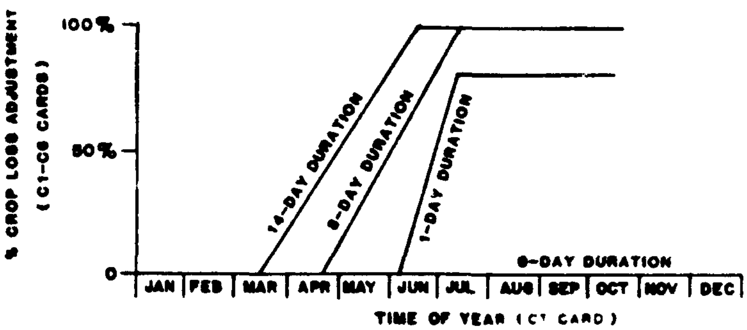
TABLE 4.2

JULIAN DAYS OF YEAR

DAY OF MONTH	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	DAY OF MONTH
	JULIAN DAY OF CALENDAR YEAR												
1	1	32	60	91	121	152	182	213	244	274	305	335	1
2	2	33	61	92	122	153	183	214	245	275	306	336	2
3	3	34	62	93	123	154	184	215	246	276	307	337	3
4	4	35	63	94	124	155	185	216	247	277	308	338	4
5	5	36	64	95	125	156	186	217	248	278	309	339	5
6	6	37	65	96	126	157	187	218	249	279	310	340	6
7	7	38	66	97	127	158	188	219	250	280	311	341	7
8	8	39	67	98	128	159	189	220	251	281	312	342	8
9	9	40	68	99	129	160	190	221	252	282	313	343	9
10	10	41	69	100	130	161	191	222	253	283	314	344	10
11	11	42	70	101	131	162	192	223	254	284	315	345	11
12	12	43	71	102	132	163	193	224	255	285	316	346	12
13	13	44	72	103	133	164	194	225	256	286	317	347	13
14	14	45	73	104	134	165	195	226	257	287	318	348	14
15	15	46	74	105	135	166	196	227	258	288	319	349	15
16	16	47	75	106	136	167	197	228	259	289	320	350	16
17	17	48	76	107	137	168	198	229	260	290	321	351	17
18	18	49	77	108	138	169	199	230	261	291	322	352	18
19	19	50	78	109	139	170	200	231	262	292	323	3535	19
20	20	51	79	110	140	171	201	232	263	293	324	354	20
21	21	52	80	111	141	172	202	233	264	294	325	355	21
22	22	53	81	112	142	173	203	234	265	295	326	356	22
23	23	54	82	113	143	174	204	235	266	296	327	357	23
24	24	55	83	114	144	175	205	236	267	297	328	358	24
25	25	56	84	115	145	176	206	237	268	298	329	359	25
26	26	57	85	116	146	177	207	238	269	299	330	360	26
27	27	58	86	117	147	178	208	239	270	300	331	361	27
28	28	59	87	118	148	179	209	240	271	301	332	362	28
29	29		88	119	149	180	210	241	272	302	333	363	29
30	30		89	120	150	181	211	242	273	303	334	364	30
31	31		90		151		212	243		304		365	31



a. Crop Loss Function (Potential Loss Available)



b. Duration Loss Adjustments

The crop loss function defines the potential loss of a crop throughout the year. The percent loss values are input on CB cards and the corresponding days of the year on CT cards (see the below table). The percent values are converted to dollars, based on the yield and price (gross value) of the crop (see Exhibit E1 for example calculations).

The duration loss adjustments values are the percent of the crop damaged by duration of flooding. The values are input on C1-C6 cards corresponding to the days of the year on CT cards (see the below table). These values are multiplied by the crop loss potential values to determine the crop damage of an event occurring at a specific date with a given duration of flooding (see Exhibit E1 for example calculations).

CROP LOSS PER ACRE

(PERCENT LOSS VALUES)

DATE	DAY OF YEAR (CT CARD)	POTENTIAL PERCENT LOSS (CB CARD)	PERCENT LOSS BY FLOOD DURATION (DAYS) 0-DAY (C1 CARD)	1-DAY (C2 CARD)	3-DAYS (C3 CARD)	14 DAYS (C4 CARD)
15 Mar	74	0	0	0	0	0
21 Apr	111	25	0	0	0	45
7 Jun	158	60	0	0	100	100
7 Jul	188	100	0	75	100	100
15 Sep	258	100	0	75	100	100
21 Oct	294	0	0	75	100	100

Figure 4.1 CROP AND DURATION LOSS FUNCTIONS

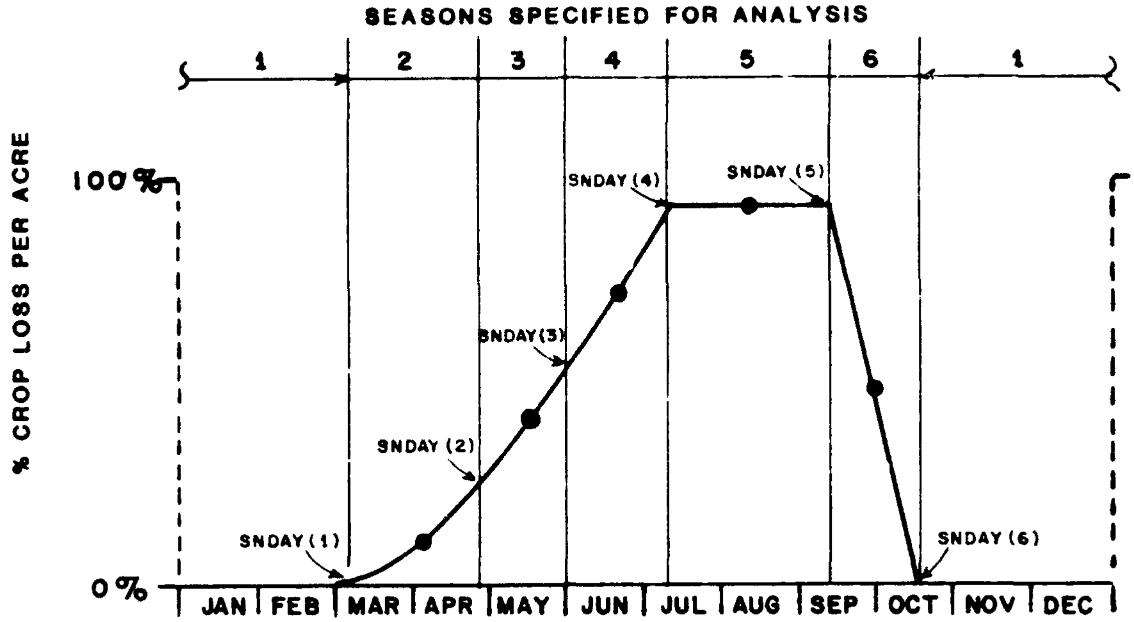
4.3 Season Concepts

4.3.1 General. Flood damage to crops is determined for each hydrograph event by calculating the damage potential by seasons. Season damage value is determined and weighted based on the proportion of time the event occurs in the season. The weighted seasonal damage values are then summed to produce the total crop damage associated with the event. Figure 4.2 provides important concepts associated with the program data input and seasonal analysis.

4.3.2 Event Frequency. Event frequency data, input on FT and FR cards, specify titles and corresponding percent chance exceedance values used in the damage analyses and output in summary tables. Hydrographs input on H1 through H9 cards are interpolated, based on input (actual) percent chance exceedance values on the HF cards, to be consistent with the job values on the FR card.

4.3.3 Event-Season Weightings. The calculation and weighting of crop damage by seasons for each event necessitates the determination of the proportion of time the event occurs in each of the seasons. The sum of the seasonal values must equal one for each event. The values are used to calculate a weighted damage value for the event.

The proportion of time that an event occurs in a season is often determined by analysis of gaged records in the region. The seasonal proportions are typically based on the magnitude of the event. For instance, the proportion of the time a small event occurs throughout the year might be relatively uniform in any month. However, the proportion of time that a rare event occurs might be more concentrated in the spring season. The P1 through P9 cards are used to input the proportion of time events occur in each season. Table 4.3 provides an example of event weighting values for four seasons.



CROP LOSS FUNCTION

- Specific crop flood damage analyses are performed for each event by calculating the damage potential by seasons-of-the-year. Individual season damage values are determined and weighted based on the proportion of time the event occurs in each season. The weighted values are summed to produce the total crop damage associated with the event.

- The season titles, used for output tables and summaries, are input on the SN card. A maximum of 12 seasons may be used for the job. The specified seasons are used for each crop analyzed for the job.

- The dates of the seasons are input by variable SNDAY(N) on the SD cards (See above figure). Seasons are defined by the first Julian date of the season, except for the last season which must also include the ending date.

- Seasons definitions are based on crop loss functions and changes in hydrologic runoff conditions. The beginning and ending Julian dates of the seasons do not have to coincide with the Julian dates used to define the crop loss functions.

- The damage for a season is determined by averaging the damage potential for the beginning and ending Julian days of the season. (see above figure.)

- A winter season may begin in the fall of the year and continue through the beginning months of previous year. (Season 1 in the above figure.)

Figure 4.2 SEASON ANALYSIS CONCEPTS

TABLE 4.3

EXAMPLE EVENT-SEASON WEIGHTINGS

% CHANCE EXCEEDANCE EVENT (FR CARD)	PROPORTION OF TIME OCCURRING IN SEASON			
	SEASON 1 (P1 CARD)	SEASON 2 (P2 CARD)	SEASON 3 (P3 CARD)	SEASON 4 (P4 CARD)
50	10	40	40	10
20	10	40	40	10
10	5	50	40	5
4	5	60	30	5
1	5	70	20	5

4.4 Damage Reach Data

4.4.1 General. Damage reaches are used to define boundaries for data aggregation, analysis, and reporting. Figure 4.3 shows the damage reach concept. Damage reach data used by the program include: damage reach title, crop categories found in reach, crop distribution patterns, elevation-area and elevation-discharge (rating curve) relationships. These reach parameters are input on DR, DT, EV, QQ, ZR, EL, AR, ZC, CP, and CA cards.

4.4.2 Damage Reach Delineation. Damage reach delineation requires coordination between economists, hydrologic engineers, and hydraulic engineers. Damage reaches require consistent (essentially parallel throughout reach) water surface profiles for the range of flows that can cause significant flood damage potential. Damage reach boundary delineation must also consider the availability of hydrologic (hypothetical frequency hydrographs) data and existing and possible future flood control project locations. Damage reaches are also delineated based upon reporting requirements, along political boundaries, or where significant differentiation of the nature of damage (for example, urban versus agricultural) occurs.

4.4.3 Damage Reach Index Locations. Damage reach index locations are common points where crop damage (area-elevation) is aggregated and rating

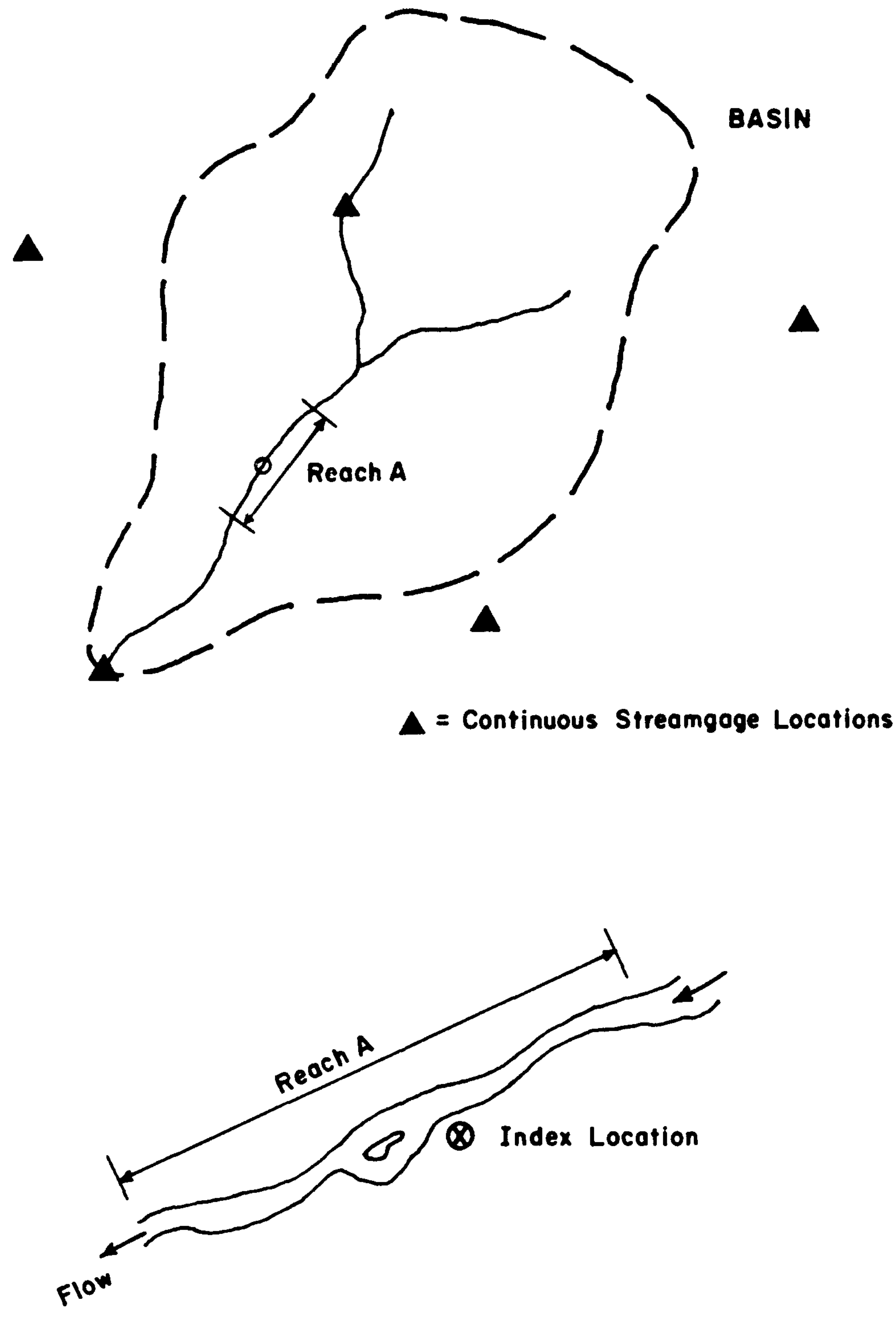


Figure 4.3 DAMAGE REACH CONCEPT

curves and event hydrographs are developed. The index location may be anywhere in the reach, but is commonly located where reliable discharge-frequency and water surface profile data may be determined. (See Figure 4.3).

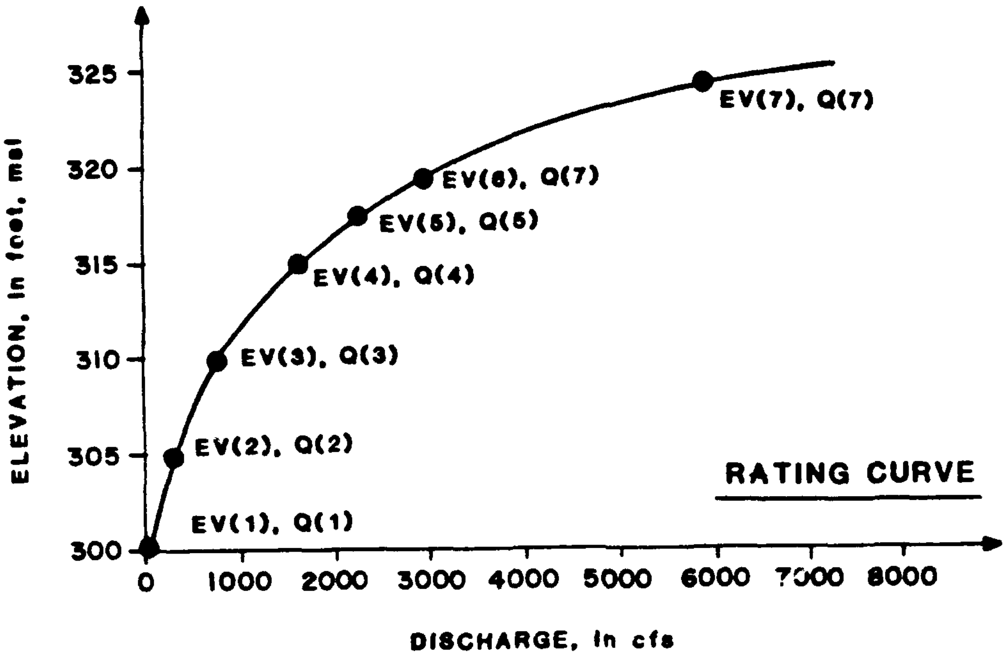
4.4.4. Discharge-Elevation (Rating Curve) Functions. Discharge-elevation (stage) functions, or rating curves are specified on the EV (elevation) and QQ (discharge) cards. See Figure 4.4. A maximum of 18 points may be used to define the discharge-elevation relationship. Calculations involving intermediate values are determined by linear interpolation.

The discharge-elevation functions are used to convert discharge based hydrograph ordinates to elevation (stage). The EV and QQ cards are therefore required only when event hydrographs are discharge-time ordinates. The cards are omitted if the hydrograph ordinates are elevation (stage)-time based.

4.4.5 Crop Distribution Patterns. Crop distribution patterns define the types of crops within a damage reach and how they are distributed spatially (by area) throughout the range of elevations of the reach. The program enables users to specify the crop distribution by constant percentages throughout the range of elevation values or by unique elevation-area functions associated with each crop.

A constant distribution of crops throughout the entire elevation range is often assumed in study applications. However, a constant distribution is often not representative of the reach. For example, lower wet areas may be planted in rice, whereas adjacent higher grounds are planted in soybeans. Unique elevation-area functions for each crop are subsequently necessary to adequately reflect this crop distribution.

Analyses involving a constant crop distribution over the elevation range of the entire agricultural crop area are input on EL (elevation) and AR (area) cards. The crop categories and distribution percentages of each crop are specified on CP cards. Figure 4.5 shows an example of data associated



- Rating curve (elevation-discharge relationships) are required at damage reach index locations when variable RATE (DR.4) equals zero. The rating curve converts discharge ordinates to elevation (stage) values.

- Elevation values are input on EV cards and associated discharge values are input on QQ cards.

- The initial elevation-discharge value normally corresponds to zero discharge. It must be less than any hydrograph ordinate value analyzed for the reach.

- The maximum discharge value must be greater than any hydrograph ordinate value analyzed for the reach.

- Linear interpolation is used to estimate values between points. A maximum of 18 values (points) may be used to define rating curve.

Figure 4.4 DISCHARGE - ELEVATION (RATING CURVE) FUNCTIONS

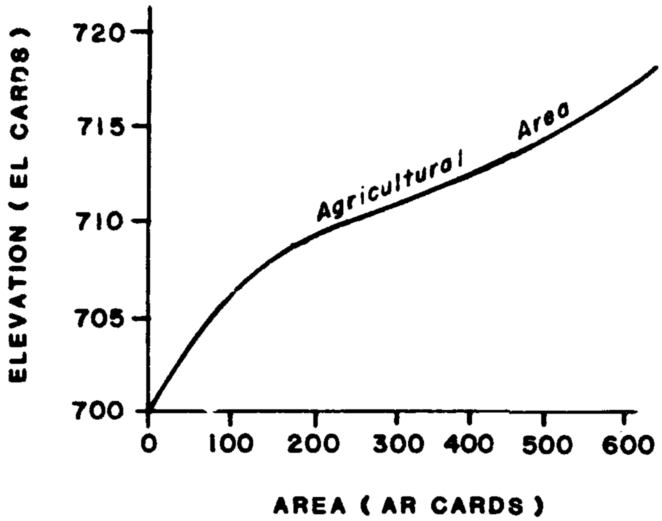


Figure 4.5 TOTAL CROP ELEVATION - AREA RELATIONSHIP

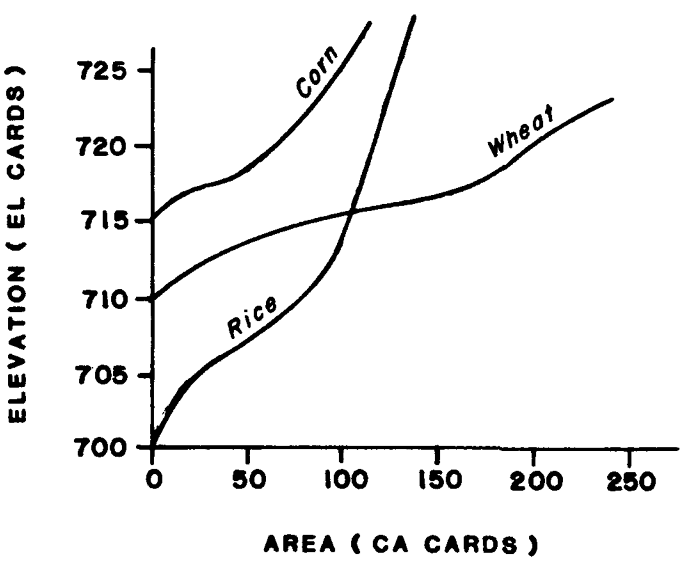


Figure 4.6 INDIVIDUAL CROP ELEVATION - AREA RELATIONSHIPS

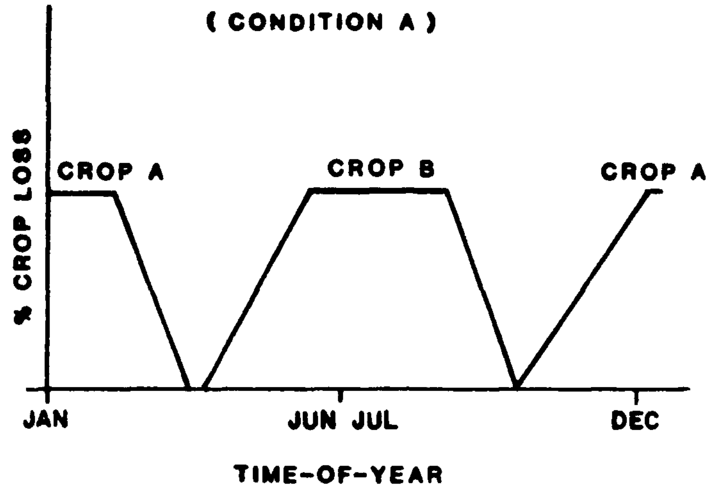
with input of a total agricultural crop elevation-area relationship. A maximum of 18 points may be used to specify the elevation-area curve. Program calculations involving intermediate values are linearly interpolated.

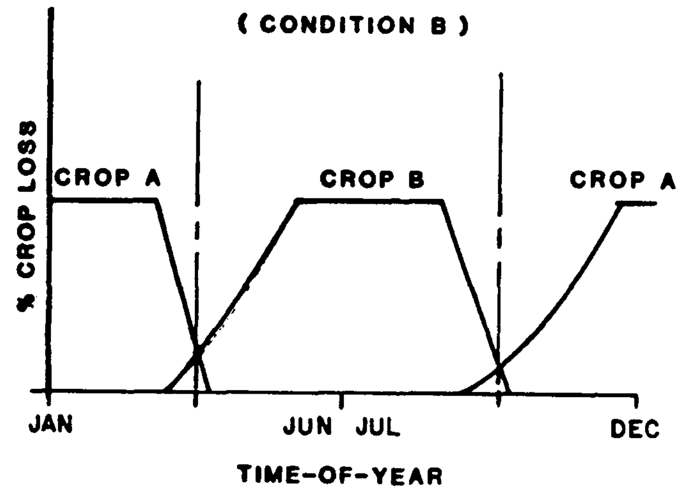
Users specifications of individual elevation-area functions for each crop are input on EL (elevations) and CA (area) cards. Figure 4.6 shows an example of data typically associated with unique elevation-area functions per crop. A maximum of 18 points may be used to specify the function. Intermediate values are linearly interpolated.

4.4.6 Double Cropping Specifications. The AGDAM program enables the users to evaluate effects of double cropping, the planting of a second crop after the first crop is harvested. The crops to be double cropped are input individually. Crops are specified as double crops on the CP card. Figure 4.7 describes and illustrates the double cropping procedures used by the AGDAM program.

4.4.7 Hydrograph Data Requirements. The primary hydrologic data are frequency hydrographs. A frequency hydrograph is defined as a hydrograph which has the peak, volume, and all durations statistically consistent with respect to the percent chance exceedance assignment of the event. A set (for example, 50, 20, 10, 4, 2, 1, and .5 percent chance exceedance events) of hydrographs may be developed and used for analysis of specified seasons.

A set of frequency hydrographs may be used for one or all seasons evaluated. For example, if four seasons, winter, spring, summer, and fall, are to be analyzed, the snowmelt set of hydrographs may be applied to analyze the winter season and the rainfall hydrographs the other three seasons. Normally, hydrologic runoff characteristics are consistent enough for rainfall and snowmelt seasons that not more that two sets (rainfall and snowmelt) of hydrographs are used in the analysis. The damage potential to crops should also be considered. For example, if damage does not occur during the snowmelt flood season, unique assessments of the snowmelt hydrologic conditions is not warranted. Figure 4.8 depicts snowmelt and rainfall sets of frequency hydrographs.





- Users may specify double cropping conditions by using two crop titles on the reach CP card. Elevation-area data for the double cropped area must be input on EL, CA or AR cards.

- Crop loss functions for the two double crops are combined into a single function (Condition A). The two functions should not intersect, as shown in condition B. If the functions do intersect, the intersection point is assumed the beginning and ending point of the two functions.

- Crop loss functions for double crops may extend past the end-of-the-year. For example, Crop A of Condition A begins in the fall and extends past the beginning of the year until spring. The Crop A loss function must be appropriately defined on the job crop cards (CR, CT, CB, CD, C1-C6).

Figure 4.7 DOUBLE CROPPING CONCEPTS

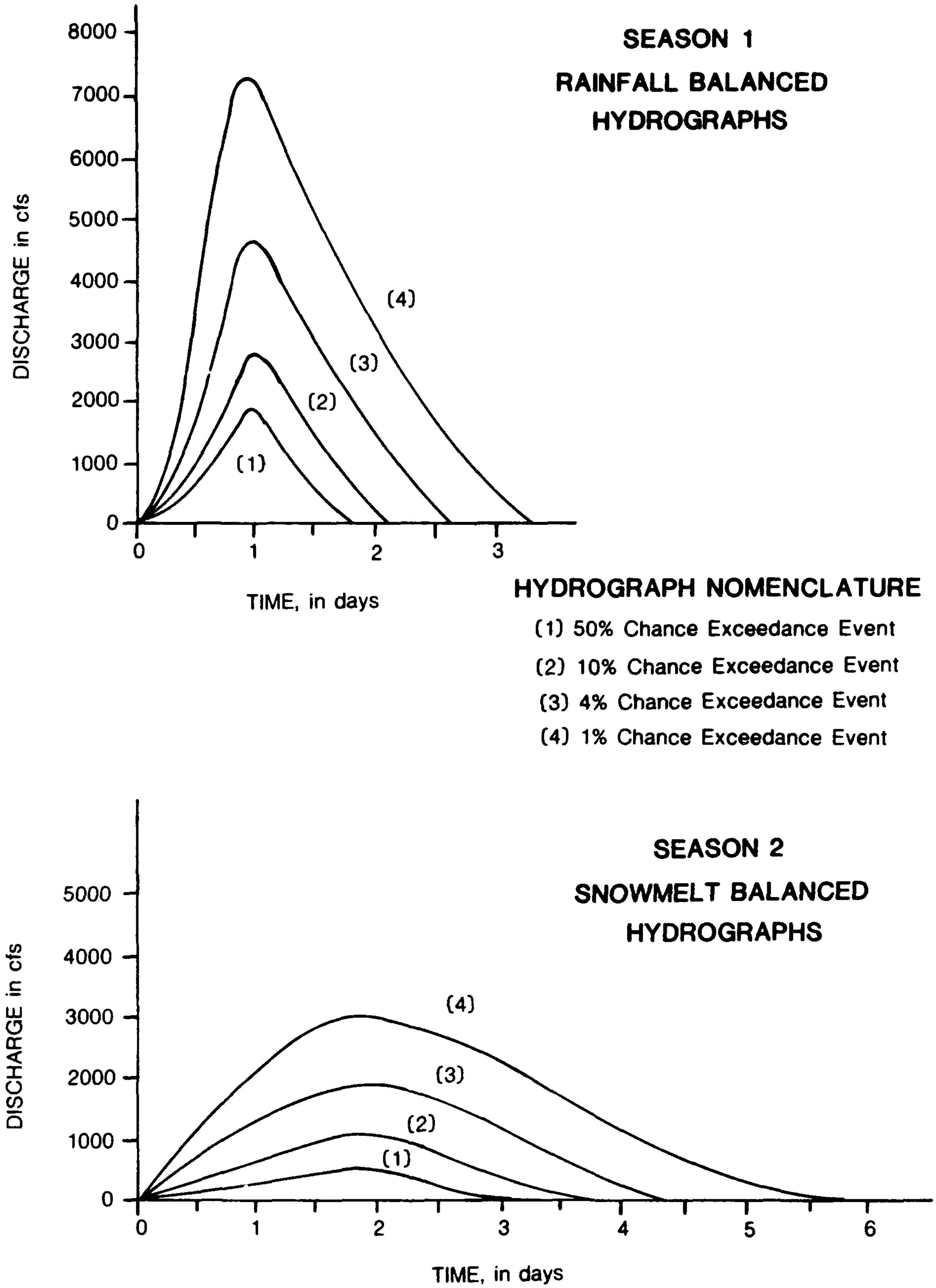


Figure 4.8 FREQUENCY HYDROGRAPH CONCEPTS

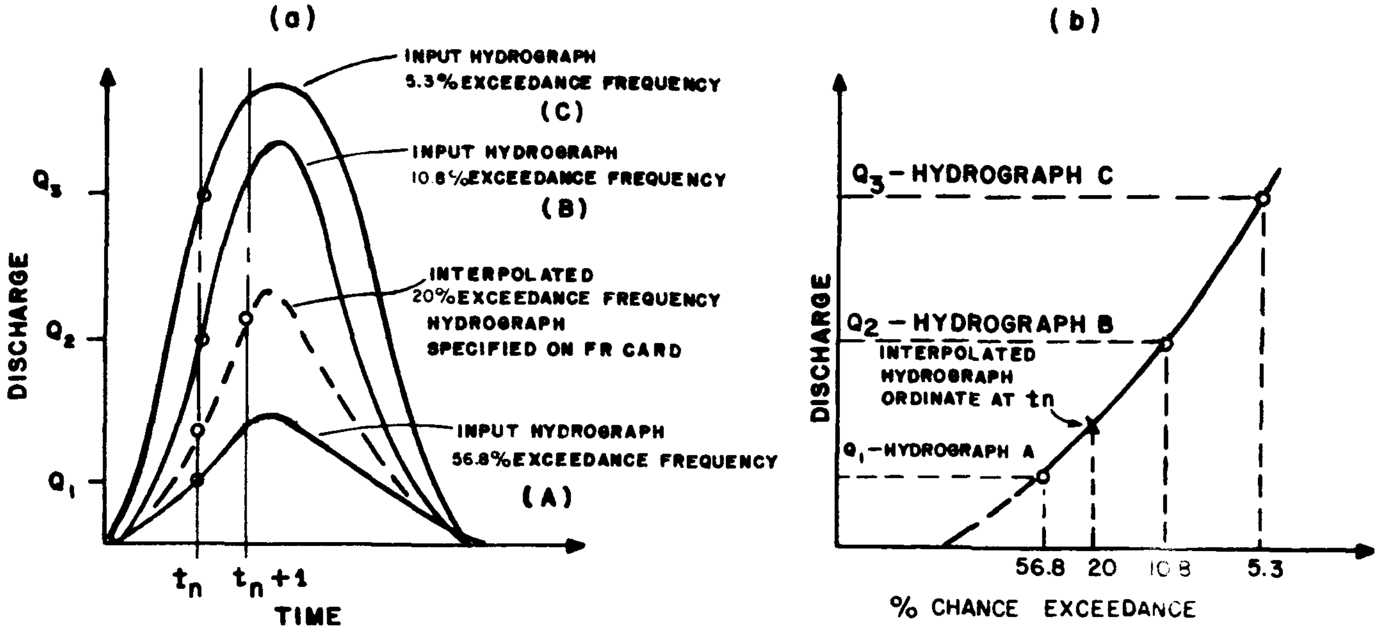
Frequency hydrographs may be derived directly from historic data at gaged locations or synthetically at ungaged locations. The hydrographs may have either elevation (stage) or discharge based ordinate values. The time interval between ordinates must be the same for all hydrographs analyzed for a given reach (Hydrologic Engineering Center 1981).

Hydrograph data are input on QD, HQ, HF, and H1-H9 cards. A set of these cards is required for each damage reach. The QD card specifies the title, elevation (or discharge) ordinate values, and the time interval of the hydrographs. The HQ card specifies for which seasons (maximum of 12) the set of hydrographs are to be used in the damage analyses. The H1-H9 cards are used to input the hydrograph ordinates. The initial hydrograph (maximum of 150 ordinate values) is input on the H1 cards; the second hydrograph on the H2 cards; etc., up to nine events.

Hydrograph frequency assignments are input on the HF card. If the values are different from those on the FR card, the program interpolates the input hydrographs, ordinate by ordinate, to provide similar hydrograph frequency assignments specifed on the FR card.

Figure 4.9 shows the basic concepts of the interpolation process. The interpolation procedure is required so that consistent events can be used to determine event damage values by seasons and reaches. The user should input minimum and maximum extreme events on the H1 and H9 cards, respectively. The event range should be greater and less than the frequency hydrographs assignments specified on the FR card to assure appropriate interpolated values. If the input hydrograph frequency values do not exceed (higher and lower) the values on the FR card, the largest and smallest frequency values on the FR card are assumed by the program.

The interpolation procedure also minimizes the number of input hydrographs required. A possible set of hydrographs may have 50, 20, 10, 4, and 1 percent chance exceedance events on the H1-H9 cards. The program may subsequently generate up to 9 hydrographs for analysis with percent chance exceedance assignments as specified on FR cards.



INTERPOLATED HYDROGRAPH

ORDINATE VALUES AT TIME tn

- The AGDAM program generates hydrographs with consistent season and damage reach frequency assignments. Consistent frequency assignments to flood hydrographs are required to sum weighted season damage (area flooded) values and to total event damage for all reaches.

- Desired frequency hydrograph assignments for output display are input on FR cards. The program uses frequency and hydrograph ordinate values input on HF and H1-H9 cards to interpolate the job frequency hydrographs specified on FR cards. The program interpolation is performed using a cubic-polynomial curve fit routine applied to each hydrograph ordinate value as depicted in the above figure.

- An example of the need for consistent hydrograph frequency assignments is in the use of the HEC-1, Flood Hydrograph Package, used to generate runoff hydrographs. The HEC-1 ratio hydrograph option may be used to develop seasonal sets of hydrographs at desired location (users are cautioned to verify the validity of the shape and volume of these events). The frequency assignments between seasonal sets of hydrographs are often different within the same reach and from reach to reach. The interpolation routine of the AGDAM program enables users to generate a minimum number of input hydrographs.

- Input hydrographs on the H1-H9 cards should include a more frequent and a more rare event than that specified for output on the FR card. This enables proper interpolation between hydrograph ordinates. A minimum of four input hydrographs are normally required to assure appropriate interpolation.

Figure 4.9 HYDROGRAPH INTERPOLATION PROCESS

4.5 <u>Flood Damage Analysis Procedures</u>

The following paragraphs summarizes the analytical procedures used by the program to calculate expected annual damage by crop category and damage reach. (Appendix E, Exhibit E-1, provides a detailed hand computation example illustrating the procedures.)

(1) Develop crop damage functions based on input crop value (gross value minus harvest cost) and crop loss functions.

(2) Divide the range of elevations (elevation-area relationship) input on the EL and AR or CA cards into flood zones. The zones are determined by the elevation values input on the El card. Figure 4.10 depicts the flood zone concept.

(3) Determine the incremental agricultural area for each zone. Calculations are performed for total agricultural area if AR card is input and for individual crop areas when CA cards are used (See Figure 4.10). The total agricultural crop area (when AR cards are input) is subsequently proportioned based on crop distribution percentages input on CP card.

(4) Convert discharge based hydrograph ordinate values to elevations (stages) using the rating curve input on the EV and QQ cards.

(5) Determine the duration of flooding (for the event being analyzed) for each zone. See Figure 4.11.

(6) Calculate the individual seasonal damage associated with the event being analyzed for each crop and zone (damage by crop and season). The calculations are based on the season, percent crop loss for the duration of flooding (Figure 3.1b), and crop loss function (Figure 3.1a). The damage is determined by summarizing the totals for the flood zones.

(7) Develop the event weighted season damage values by multiplying the proportion of time the event occurs in the season by the calculated damage total determined in step 6.

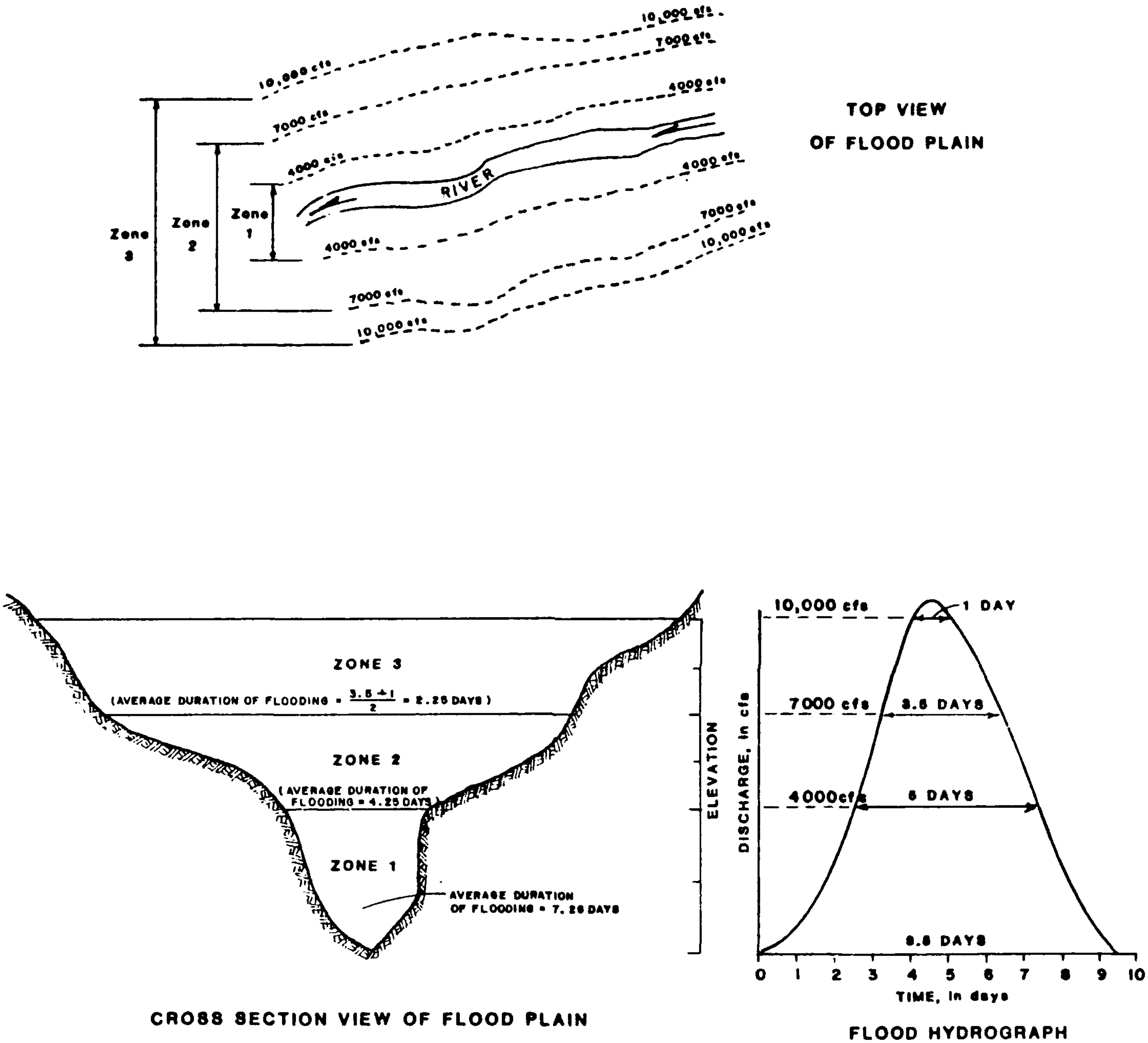
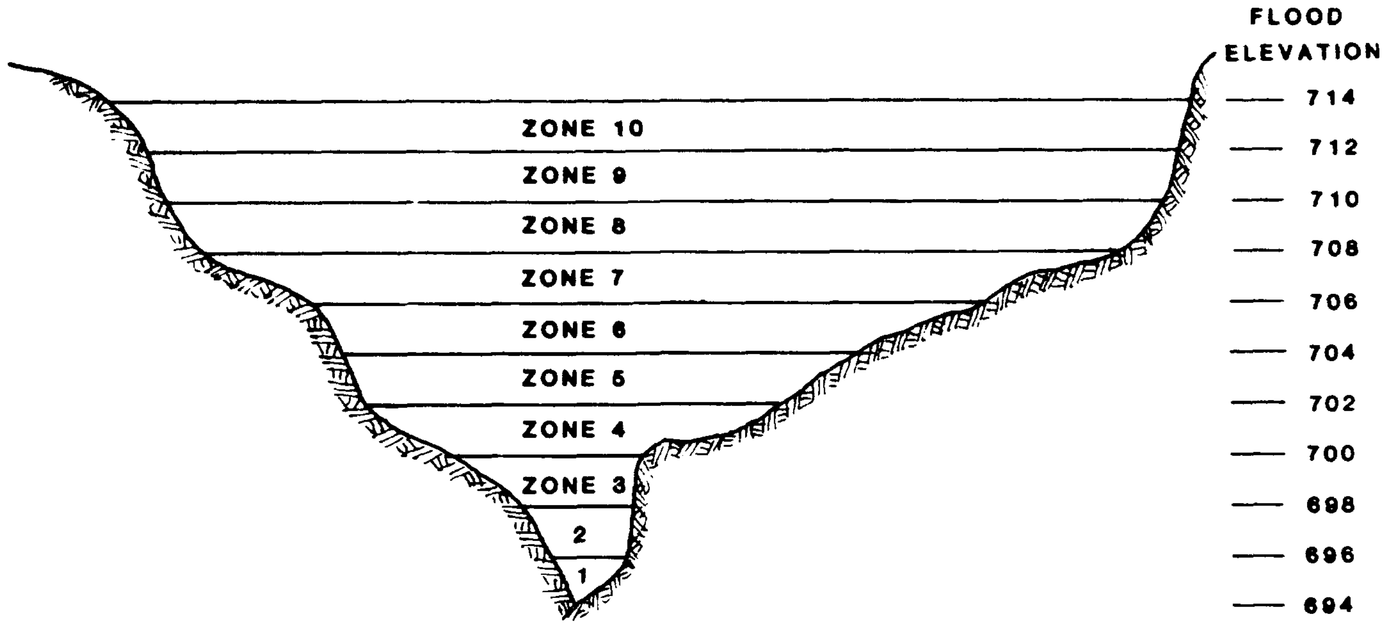


Figure 4.10 DURATION OF FLOODING BY ZONES



- Event damage (for each season described in Figure 4.2) are determined by summing the calculated damage associated with each flood zone. This procedure enables the variation in duration of flooding throughout the range of flood plain elevations to be considered.

- The flood zones are determined by the input elevation values on the EL card. The first and second values define zone one, the second and third zone two, etc. A maximum of 17 zones (18 elevation values on the EL card) may be used in the damage calculation.

- The set of elevation values on the EL card must include the range of potential crop area flooded for both large and small events. This assures proper damage calculations.

- The test problems in Exhibit E-1, and E-2 depict the zone calculation procedures.

Figure 4.11 FLOOD ZONE DETERMINATION PROCEDURES

(8) Sum the weighted seasonal damage values to obtain the total event damage by the crop.

(9) Calculate expected annual damage for each crop by integrating the frequency-damage relationship developed for each event. (See Figure 4.12).

(10) Adjust expected annual damage value for multiflood replant factors and infrastructure damage associated with each crop.

The flooded area computations are performed in a similar manner to the damage calculations.

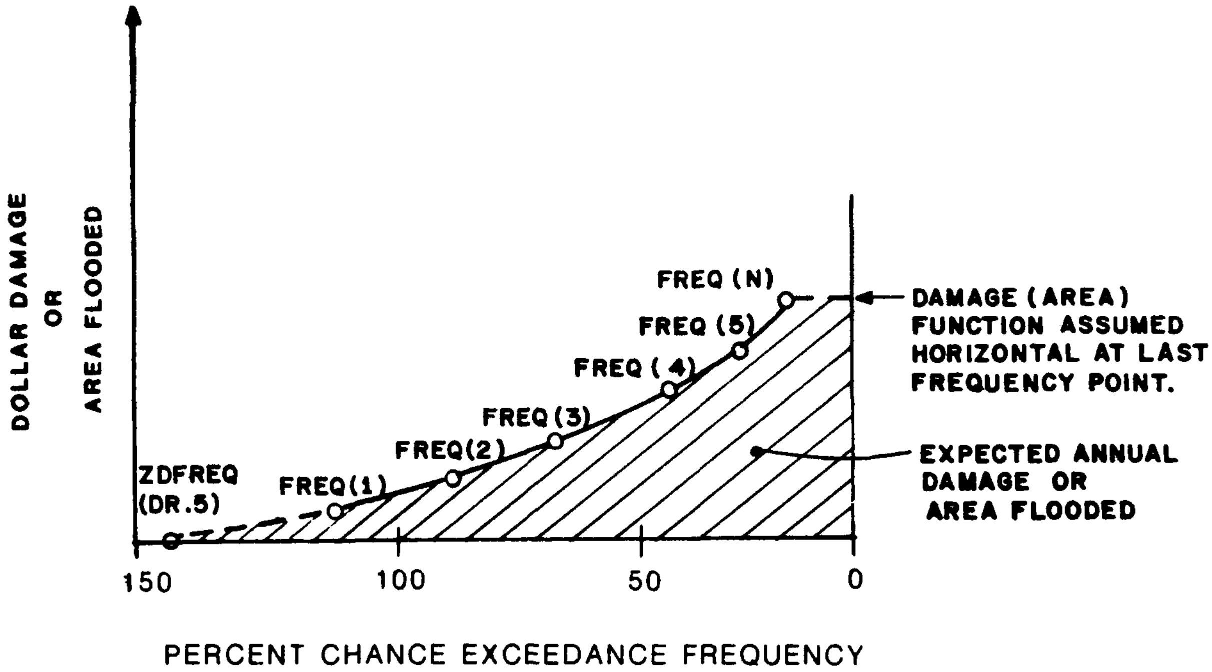
5.0 INPUT DESCRIPTION

5.1 General Description

This section describes the basic concepts and structure of input to the AGDAM program. Specific input information described includes the definition of the heirarchy of data sets in the program and summary of input requirements for applications. A detailed program input description is provided in Appendix F. Appendix B provides a glossary of input data variables, and Appendix E provides example problems with descriptions of associated input requirements and output results.

5.2 Program Data Hierarchy

The general hierarchy of the input structure of the program is displayed in Table 5.1. The program is designed for the user to designate job titles, analyses to be performed, and output specifications.



- Expected annual damage and area flooded values are determined by calculating the damage (area flooded) associated with each frequency event (FREQ) specified on the FR card and integrating the function as illustrated above. Reference Hydrologic Engineering Center, "Expected Annual Flood Damage Computation", computer program users manual for detailed integration procedures.

- The initial frequency event FREQ(1)(FR.1) should be associated with zero damage. If not, variable ZDFREQ (DR.5) is used to define the zero damage point.

- The last event input (rarest exceedance frequency) is used to define the maximum damage potential as depicted above; see FREQ(N). The function is defined by assuming a horizontal line from FREQ(N) to the zero frequency location. It is therefore important to analyze a rare event (say .5% chance exceedance (500-year) or greater) to appropriately define the damage (flooded area)-exceedance frequency relationship to be integrated.

- If on the average more than one damaging event per year occurs the input should be as 200 (two times per year), 150 (one and one-half times per year), 100, 50, etc., on the FR card.

Figure 4.12 EXPECTED ANNUAL DAMAGE AND AREA FLOODED ANALYSIS

TABLE 5.1

PROGRAM DATA HIERARCHY

TITLE CARDS	Applies to Each Job
JOB CARDS	
• Defines Analysis Specifications	
• Specifies Input-Output	Applies to Each Job
• Price Index Factor	
CROP CARDS	
• Specifies Type and Value of Crops	Applies to Each Job
• Specifies Crop Has Damage Potential Throughout Year	
SEASON CARDS	
• Defines Seasons to be Analyzed	Each Season
EVENT FREQUENCY CARDS	
• Specifies Event Titles and Associated Exceedance Frequency Values	
• Specifies Seasonal Weightings	Each Event
DAMAGE REACH CARDS	
• Defines Reach Analyses	Applies to Each
• Defines Elevation-Area Relationships	Damage Reach
• Specifies Crop Categories and Distribution	
HYDROLOGIC DATA CARDS	
• Defines Hydrologic Specifications	Applies to Each
• Input Seasonal Sets of Balanced Frequency Hydrographs	Damage Reach

5.3 Input Data Description

5.3.1 Title Cards (T1, T2, T3). Three title cards are required. They provide output display information used to identify the project and job. The content of the title cards is optional, but it is suggested that it include a record of the project name, data notes, selected program options, and any unique features of the job. The information on the title cards is printed at the top of each page of the computer printout.

5.3.2 Job Specifications Card J1 Card. This required card specifies the type of analysis to be performed and the output options desired.

5.3.3 Crop Cards (CR, CT, CB, CD, C1-C6). The crop cards define crop data to be analyzed for the job. A set of data cards is required for each crop to be evaluated. These values are typically constant for large geographic regions and Corps of Engineers Districts.

- CR Card. The required CR card specifies the type, unit price, and yield associated with the crop. Table 4.1 shows typical crop data input requirements.

- CT Card. This required card specifies the Julian day of the calendar year corresponding to the percent potential loss values (investment plus net revenue) of the crop (CB Card), and duration percent loss values (CD and C1-C6 cards). Table 4.2 provides Julian day values for each calendar day. Figure 3.1 depicts typical crop budget (loss potential) and percent loss for specified durations throughout a typical year.

- CB Card. The required CB card specifies the potential loss of a crop throughout the year. Input values are percent of loss associated with flooding. The values must correspond to Julian days of the year input on the CT card. Figure 3.1 depicts a typical crop loss diagram.

- CD Card. The required CD card specifies the numeric label for duration of flooding values (C1-C6 cards) in days (0, 1, 3, 7, etc.). The first label corresponds to the C1 card, the second the C2 card, etc.

- C1-C6 Cards. These required cards specify percent loss values due to the duration of flooding specified on the CD card. See Figure 3.1.

5.3.4 Season Cards (SN, SD). The required season cards specify the title and associated beginning Julian day of each season used in the crop damage analyses. Seasonal specifications are typically based on critical changes in loss potential and in hydrologic runoff such as snowmelt and rainfall conditions. Up to 12 seasons may be specified. Each season should be of sufficient length to have the entire duration of flood events occurring within the season. Figure 4.2 depicts the designation of seasons with respect to a crop budget diagram.

- SN Card. The required SN card specifies the title or label of each of the seasons.

- SD Card. This required card specifies the initial Julian day of the year associated with each of the seasons designated on the SN card.

5.3.5. Event Frequency Cards (FT, FR, P1-P9). These required cards specify the title of the hypothetical frequency events, associated frequency (percent chance exceedance) of each event, and the proportion of time the event occurs in each season (SN and SD cards).

- FT Card. This required card specifies the title (label) of each of the flood events to be analyzed.

- FR Card. The required FR card defines hydrograph frequency assignments as percent chance of exceedance for the job. The reach input hydrographs, which have different exceedance frequency assignments, are interpolated to the job FR frequency values.

- <u>P1-P9 Cards</u>. The <u>required</u> P1-P9 cards specify the proportion of time each flood event occurs in each season. Table 4.3 gives an example of the seasonal proportion values associated with specified percent chance exceedance events.

5.3.6 <u>Damage Reach Cards: DR, DT, EV, QQ, ZR, EL, AR, ZC, CP, CA</u>. Damage reach cards are <u>required</u> for each reach to be analyzed. The DR and DT cards specify reach analysis parameters and reach titling information, respectively. The EV and QQ cards specify the elevation and discharge relationship (rating curve), respectively, at the damage reach index location. The CP card specifies the crops to be analyzed for the reach and the EL card the elevations associated with total crop area (AR card) or individual crop area on the CA cards.

- <u>DR Card</u>. The <u>required</u> DR card defines the damage reach specifications and subsequent input requirements for the reach.

- <u>DT Card</u>. This <u>required</u> card provides an alphanumeric description or identification of the damage reach.

- <u>EV Card</u>. <u>Optional</u> card used to define elevation values of a rating curve. The elevation values must correspond to discharge values on the QQ card. Figure 8 depicts the basic input relationships of the rating curve.

- <u>QQ Card</u>. <u>Optional</u> card used to define the discharge values of a rating curve. The input discharge values must correspond to elevation values on the EV card.

- <u>EL Card</u>. The EL card is <u>required</u> if elevation data are input and not read from the DSS file. The input data are elevations associated with area data input on AR or CA cards. The initial elevation data should correspond to the zero damage (zero cultivated area) to assure proper analytical results.

- AR Card. An optional card that specifies the total area of the reach. Values must correspond to elevation values of the EL card.

- CP Card. The required CP card specifies crop titles and distribution for the reach.

- CA Card. The optional CP card defines the area values of each crop associated with the elevation values on the EL card.

5.3.7 Hydrologic Data Cards QD, HQ, HF, H1-H9. These cards are used to specify frequency hydrograph data for each reach. Frequency hydrographs are defined as hydrographs generated at a location so that the peak, volume, and all durations are statistically consistent with respect to the frequency assignment of the event. A set of hydrographs (range of frequency events) may be developed and used in the analysis for each season. The hydrographs are typically derived from use of hypothetical frequency rainfall values. Figure 4.8 depicts individual sets of frequency hydrographs associated with rainfall and snowmelt conditions. Each set of hydrographs may be used for analyses of one or more seasons.

- QD Card. The required QD card specifies the hydrologic data to be input for the damage reach index location. The card defines whether or not input hydrograph data are elevation or discharge based and if the ordinates are input directly or read from the DSS file.

- HQ Card. The HQ card is required for each seasonal set of frequency hydrographs to be input for the damage reach. The rainfall frequency hydrographs depicted in Figure 4.8 equates to one set of hydrographs and the snowmelt events another.

- HF Card. The optional HF card is required when the hydrograph values are input directly and not retrieved from the HEC Data Storage System (ZH Card). The HF card specifies exceedance frequency assignments associated with the input hydrographs on the

H1 through H9 cards. A blank HF card assumes the frequency values of the hydrographs specified on the FR cards are identical to those on the H1 through H9 cards.

- H1-H9 Cards. These cards input hydrograph ordinate values for the frequency events. Values may be either stage (elevation) or discharge based.

5.3.8 End-of-Job Card: EJ. The required EJ card specifies the end-of-job.

6.0 OUTPUT DISPLAY

6.1 General

The description of the output presented in this section corresponds to the example printout of Appendix C. The discussion and example are included to familiarize users with program options and output displays. Numbers in parentheses in the text refer to specific lines in the Appendix C - Output Display.

6.2 Description of Example Output

6.2.1 Input Listing. An example display of the input data sequence (1) is provided at user request.

6.2.2 Title. The title card information is printed at the top of each output page (2).

6.2.3 Job Card. The job card data are displayed in card image format (3) prior to more descriptive definition of the variables. The variable and input values follow with a brief description of each variable (4).

6.2.4 Crop Input Data. Crop value input data are output (5) for expedient review. Crop loss functions as input are displayed as percent loss values (6) and dollar loss values (10). The calendar and Julian day (7), percent and dollar loss (8) by duration (9) are displayed in tabular form.

6.2.5 Event Weightings by Season. The proportion of time frequency events occur during the specified seasons are output in tabular form (11).

6.2.6 Damage Reach Specifications. Damage reach input specifications are displayed (12) for expedient user review.

6.2.7 Rating Curve Data. The input elevation-discharge values are output in a table (13) for user review.

6.2.8 Flood Zone Data Summary. Flood zone data (14) used to calculate the event damage are optionally output for user needs. The flood zone number (15), the minimum-maximum elevations of the zone (16), the total area of each zone (17), and respective area of each crop (18) are displayed.

6.2.9 Input Exceedance Frequency Hydrographs. The data defining the input seasonal frequency hydrographs (20) are output. A list of the seasons (21) that the set of hydrographs are to be used in the analysis are displayed for user information and review. A table of time (22) and hydrograph ordinate values (23) are output for each frequency event.

6.2.10 Interpolated Seasonal Hydrographs. An output table (24) showing the interpolated hydrographs based on job exceedance frequency specifications are output. Consistent event frequency assignments are required to sum weighted seasonal damage and event damage by reaches.

6.2.11 Zone Damage Summary. The incremental zone damage summary (25) by crop event and season may be optionally output for user review. The zone number and elevation (26), duration of flooding (27), area flooded (28), and incremental zone damage (29) are output. The total area flooded and damage for the crop, event, and season are also summarized. Area flooded and damage summary tables (30) by crop categories are output for user inspection of the intermediate season and event damage calculation.

6.2.12 Event Damage and Area Flooded Summary. Calculated area flooded and damage values are output in a table (31) by crop category, event and reach. Outputs include area flooded (32), calculated direct crop damage

(33), incremental multiflood adjustment damage (34), infrastructure damage (35) and the total damage (36). Similar tables are output for each event and reach.

6.2.13 Reach Damage and Area Flooded Summaries. Summary tables for each reach depicting the event damage (37) and area flooded (38) are output for each crop category. Outputs also include expected annual damage and area flooded values by crop category and reach.

6.2.14 Job Event Damage and Area Flooded Summaries. Job summary tables of calculated crop event and expected annual damage (39), and event and expected annual area flooded (40) are output. The tables provide pertinent summary information for the entire job by combing results from all reaches.

7.0 TEST PROBLEMS

Test problems illustrating various types of calculation capabilities of the AGDAM program are included in Appendix E. The sample input and output provides users with a description of typical data and options available to execute the program. The problems also provide a data set which can be used to assure proper program operation.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

1. Carson, William D. Internal Report, "Design of a Computer Program for Agricultural Flood Damage Computations." Prepared for the Hydrologic Engineering Center, U.S. Army Corps of Engineers, February 1983.

2. Davis, Darryl W. and Webb, R. Pat., "Flood Damage Assessments Using Spatial Data Management Techniques." The Hydrologic Engineering Center, U.S. Army Corps of Engineers, 1978.

3. Detroit District Corps of Engineers, Flood Control and Fish and Wildlife Management at Shrawassee Flats, Saginaw River, Michigan and Tributaries, July 1981.

4. Eichert, Bill S. and Pabst, Arthur F., "Generalized Real Time Flood Control System Model." The Hydrologic Engineering Center, U.S. Army Corps of Engineers, 1982.

5. Hydrologic Engineering Center, Phase I Oconee Basin Pilot Study, Trail Creek Test, U.S. Army Corps of Engineers, September 1975.

6. Hydrologic Engineering Center, Expected Annual Flood Damage Computation, Computer Program Users Manual, U.S. Army Corps of Engineers, 1977.

7. Hydrologic Engineering Ceter, HEC DATA Storage System, U.S Army Corps of Engineers, 1982.

APPENDIX B

GLOSSARY OF INPUT VARIABLES

APPENDIX B

GLOSSARY OF INPUT VARIABLES

Variable	(Card Field)	Variable Definition
AREA	(AR)	Area values for area - elevation data
BUDGET	(CB)	Percent loss value of crop loss function
CAREA	(CA)	Individual crop area values
CDAY	(CT)	Julian days defining crop loss function
CRFILE	(J1.7)	Crop variable input option
CROPT	(CP.1)	Crop identification for reach analysis
CRPTIT	(CR.1)	Crop titles
CUNITS	(CR.3)	Crop units per acre
CUP	(CR.4)	Unit price of crop
CYA	(CR.2)	Yield per acre of crop
DCROP1	(CP.4)	Title of first crop of double crop
DCROP2	(CP.5)	Title of second crop of double crop
DRID	(DR.1, QD.)	Damage reach identification
DRTIT	(DT)	Alphanumeric reach title
DUR	(CD)	Duration values in days for crop loss function
DSSH	(QD.6)	Hydrograph input specifications
DSSOUT	(J1.6)	Data Storage System output options
ELAREA	(DR.2)	Input specifications for elevation-area data
EL	(EL)	Elevation values for area-elevation data
EV	(EV)	Rating curve elevation values
FREQ	(FR)	Exceedance frequency assignments to hydrograph
FRTIT	(FT)	Frequency hydrograph titles
HFREQ	(HF)	Input hydrograph titles

Variable	(Card Field)	Variable Definition
HPRNT	(QD.5)	Hydrograph output specifications
HRVCST	(CR.9)	Harvest cost in dollars per acre
HYDROD	(QD.2)	Hydrograph ordinate discharge or elevation specification
ICULT	(CR.6)	Julian day of end of cultivation
IDC	(CP.3)	Single or double crop specification
IHRVST	(CR.8)	Julian date when harvest begins
IMAGE	(J1.1)	Listing option for card image input sequence
IMATUR	(CR.7)	Julian day of crop maturity
INFRAS	(J1.4)	Infrastructure damage factor
IPLAN	(ZN,ZR,ZC,ZH)	DSS alternative (part F) pathname
IPRINT	(J1.2)	Job print specifications
IYEAR	(ZN,ZR,ZC,ZH)	DSS year (part E) pathname
MULTFD	(J1.5)	Job multiflood adjustment factor option
MULTFL	(CR.5)	Crop multiflood adjustment factor option
NQRD	(QD.3)	Number of hydrograph ordinate values
ORD	(H1-H9)	Input hydrograph ordinate values function
PCTDAM	(C1-C6)	Percent duration loss values of crop loss function
PINDEX	(J1.3)	Price index factor
PRCT	(CP.2)	Area distribution for crop
PROJ	(ZN,ZR,ZC,ZH)	DSS project (part A) pathname
Q	(QQ)	Rating curve discharge values
RATE	(DR.2)	Rating curve data input specifications
REACH	(ZN,ZR,ZC,ZH)	DSS reach location (part B) pathname
SEASN	(HQ)	Hydrograph season titles
SNDAY	(SD)	Julian day values defining seasons

Variable	(Card Field)	Variable Definition
SNTIT	(SN)	Season titles used in analysis
TIME	(QD.4)	Hydrograph time interval in minutes
TITLE	(T1,T2,T3)	Title information
ZDFREQ	(DR.5)	Zero damage elevation for reach

APPENDIX C

OUTPUT DISPLAY

AND EXHIBIT E-3 OUTPUT

1 *Listing of input data set.*

```
T1                OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
T2                AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
T3                SMITH RIVER STUDY              APRIL 1985
J1                     1.2      .25      1.2       1
ZN          SMITH                                              1984      NATURAL
CR WHEAT       40  BUSHEL      3.25               170      270      290       40
CT    80      110      130      150      200      270      290
CB     0     0.15     0.25     0.75      1.0      1.0      0.0
CD     0        1        3        7
C1
C2   0.0     0.15      0.5      0.6      0.8      0.8      0.8
C3   0.0      0.3      0.7      0.9      1.0      1.0      1.0
C4   0.0     0.45      0.8      1.0      1.0      1.0      1.0
CR  CORN      110  BUSHEL      2.75               180      250      260       50
CT    90      120      150      210      240      250      270
CB     0      .10      .30      .90     1.00     1.00        0
CD     0        1        3        7
C1     0        0        0        0        0        0        0
C2     0       .1       .5       .6       .8       .8       .8
C3     0       .3       .7       .9      1.0      1.0      1.0
C4     0       .4       .8      1.0      1.0      1.0      1.0
SN         WINTER           SPRING            SUMMER            FALL
SD     1       90      180      270
FT20% CH   10% CH    4% CH    2% CH    1% CH
FR    20       10        4        2        1
P1    10       40       20       30
P2     5       50       15       30
P3     5       50       15       30
P4     5       50       15       30
P5     5       60       10       25
DR RCH 1        2        2               1.0  AGAREA
DT                DAMAGE REACH 1  SMITH RIVER STUDY
ZR
CP  CORN       50
ZC
QD RCH 1                10      720        1
HQ
HF    20        4        1
H1     0     1000     2700     1300      200        0
H2     0     1700     4600     3200     1100      200        0
H3     0     2800     7300     5500     3300     1700      500        0
DR RCH 2        2        2                    AGAREA
DT                DAMAGE REACH 2   SMITH RIVER STUDY
ZR
CP  CORN       25
CP WHEAT       75
ZC
QD RCH 2                10      720        1
HQ
HF    20        4        1
H1     0     1000     2700     1300      200        0
H2     0     1700     4600     3200     1100      200        0
H3     0     2800     7300     5500     3300     1700      500        0
EJ
```

```
                           OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
                           AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
                           SMITH RIVER STUDY                    APRIL 1985

   J1 CARD - JOB SPECIFICATIONS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   J1                       1.2      .25       1.2        1

   IMAGE  =           0 INPUT LINE IMAGES AND VARIABLE VALUES WILL BE PRINTED
   IPRINT =           0 PRINT CROP BUDGET & LOSS TABLE, EVENT TABLE, CROP AREA TABLE AND
                        DAMAGE TABLES FOR ZONE, SEASON, EVENT, REACH AND RUN
   PINDEX =        1.20 PRICE INDEX FACTOR
   INFRAS =        0.25 INFRASTRUCTURE DAMAGE FACTOR
   MULTFD =        1.20 MULTI-FLOOD ADJUSTMENT FACTOR
   DSSOUT =           1 DAMAGE TABLES WILL BE WRITTEN TO DSS
   CRFILE =           0 CROP DATA READ FROM INPUT DECK

   ZN CARD - DSS GLOBAL PATHNAME SPECIFICATIONS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   ZN          SMITH                                                  1984         NATURAL
            -----DSS---ZOPEN NONEMPTY FILE OPENED    71   0000P49*AGDSS
```

(2) *Title card information*

(3) *J1 card image.*

(4) *Display of J1 card input values.*

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

```
CRPTIT =      WHEAT CROP NAME
CYA    =      40.00 YIELD PER UNIT AREA
CUNIT  =     BUSHEL UNITS OF YIELD
CUP    =       3.25 UNIT PRICE
MULTFL =       1.20 MULTI-FLOOD ADJUSTMENT FACTOR
ICULT  =        170 DATE OF START OF CULTIVATION
IMATUR =        270 DATE OF CROP MATURITY
IHRVST =        290 DATE OF START OF HARVEST
HRVCST =     40.00 HARVEST COST $ PER ACRE
```

5 *Crop input data.*

CROP LOSS TABLE (PERCENT LOSS VALUES)

6 *Crop loss table in percent.*

DATE	DAY OF YEAR	POTENTIAL LOSS (%)	0.0	PERCENT LOSS BY FLOOD DURATION (DAYS) 1.0	3.0	7.0
21 MARCH	80.	0.0	0.0	0.0	0.0	0.0
20 APRIL	110.	15.0	0.0	15.0	30.0	45.0
10 MAY	130.	25.0	0.0	50.0	70.0	80.0
30 MAY	150.	75.0	0.0	60.0	90.0	100.0
19 JULY	200.	100.0	0.0	80.0	100.0	100.0
27 SEPT	270.	100.0	0.0	80.0	100.0	100.0
17 OCT	290.	0.0	0.0	80.0	100.0	100.0
7	7	8	9	9	9	9

CROP LOSS TABLE (DOLLAR LOSS VALUES)

10 *Crop loss table in dollars.*

DATE	DAY OF YEAR	POTENTIAL LOSS ($)	0.0	DOLLAR LOSS BY FLOOD DURATION (DAYS) PER ACRE 1.0	3.0	7.0
21 MARCH	80.	0.00	0.00	0.00	0.00	0.00
20 APRIL	110.	19.50	0.00	2.92	5.85	8.77
10 MAY	130.	32.50	0.00	16.25	22.75	26.00
30 MAY	150.	97.50	0.00	58.50	87.75	97.50
19 JULY	200.	130.00	0.00	104.00	130.00	130.00
27 SEPT	270.	130.00	0.00	104.00	130.00	130.00
17 OCT	290.	0.00	0.00	0.00	0.00	0.00
7	7	8	9	9	9	9

Several Pages of Output Deleted

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

EVENT WEIGHTINGS BY SEASON
PROPORTION OF TIME FREQUENCY EVENT OCCURS IN EACH SEASON

SEASON	EVENT % CHANCE EXCEEDANCE VALUES				
	20.00	10.00	4.00	2.00	1.00
WINTER	10.00	5.00	5.00	5.00	5.00
SPRING	40.00	50.00	50.00	50.00	60.00
SUMMER	20.00	15.00	15.00	15.00	10.00
FALL	30.00	30.00	30.00	30.00	25.00

11 *Event weightings by specified seasons of winter, spring, summer, and fall. The table values correspond to the proportion of time an event occurs in each season. Events are those specified on FR cards for the job.*

Several Pages of Output Deleted

```
                    OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
                    AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
                    SMITH RIVER STUDY                APRIL 1985

   DR CARD - DAMAGE REACH SPECIFICATIONS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   DR RCH 2       2       2                  AGAREA

   DRID   = RCH 2 DAMAGE REACH ID
   ELAREA =     2 ELEVATION-AREA TABLE READ FROM DSS
   RATE   =     2 RATING CURVE READ FROM DSS
   IPRNT  =     0 PRINT CROP BUDGET & LOSS TABLE, EVENT TABLE, CROP AREA TABLE AND
                  DAMAGE TABLES FOR ZONE SEASON EVENT REACH AND RUN
   ZDFREQ =     0.200 ZERO DAMAGE EXCEEDANCE FREQUENCY VALUE
   AGAREA =    AGAREA DSS AG CATEGORY NAME

   DT CARD - DAMAGE REACH TITLE
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   DT               DAMAGE REACH 2   SMITH RIVER STUDY
```

12 *Damage reach 2 input data.*

```
   ZR CARD - DSS RATING CURVE INPUT
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   ZR

                                   RATING CURVE

 EV      690.0      696.0      698.0      700.0      702.0      704.0      706.0      708.0
 Q         0.0      150.0      540.0     1400.0     2700.0     5000.0    15000.0    80000.0
```

13 *Rating curve elevation-discharge relationship at damage reach index location.*

Several Pages of Output Deleted

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

(14) *Flood zone data for damage reach 2. Zones are defined from elevation values input on EL cards.*

(15) ZONE	(16) ELEVATION	(17) TOTAL AREA	CROP AREA (ACRES) (18) WHEAT	(19) CORN
1	690.0- 696.0	20.0	15.0	5.0
2	696.0- 698.0	100.0	75.0	25.0
3	698.0- 700.0	400.0	300.0	100.0
4	700.0- 702.0	1200.0	900.0	300.0
5	702.0- 704.0	2400.0	1800.0	600.0
6	704.0- 706.0	3000.0	2250.0	750.0
7	706.0- 708.0	5000.0	3750.0	1250.0

Several Pages of Output Deleted

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

INPUT SEASONAL HYDROGRAPHS

20 *Input percent chance exceedance events and corresponding ordinate values.*

WINTER
SPRING
SUMMER
FALL

21 *Seasons relative to this set of hydrographs for damage analysis.*

INPUT EVENT % CHANCE EXCEEDANCE VALUES

TIME-HRS	20.00	4.00	1.00
0.00	0.00	0.00	0.00
12.00	1000.00	1700.00	2800.00
24.00	2700.00	4600.00	7300.00
36.00	1300.00	3200.00	5500.00
48.00	200.00	1100.00	3300.00
60.00	0.00	200.00	1700.00
72.00	0.00	0.00	500.00
84.00	0.00	0.00	0.00
96.00	0.00	0.00	0.00
108.00	0.00	0.00	0.00
22	23	23	23

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

SEASONAL HYDROGRAPHS
INTERPOLATED FROM INPUT HYDROGRAPHS

WINTER
SPRING
SUMMER
FALL

24 *Interpolated frequency hydrograph ordinates from input hydrographs. Frequency assignments are specified on FR cards for job.*

JOB EVENT % CHANCE EXCEEDANCE VALUES

TIME-HRS	20.00	10.00	4.00	2.00	1.00
0.00	0.00	0.00	0.00	0.00	0.00
12.00	1000.00	1264.50	1700.00	2165.47	2800.00
24.00	2700.00	3431.23	4600.00	5774.79	7300.00
36.00	1300.00	2021.77	3200.00	4270.32	5500.00
48.00	200.00	454.69	1100.00	1956.79	3300.00
60.00	0.00	1.29	200.00	767.12	1700.00
72.00	0.00	0.00	0.00	0.12	500.00
84.00	0.00	0.00	0.00	0.00	0.00

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

DRID - RCH 2
EVENT - 10% CH
SEASON - WINTER
DATE OF CALCULATIONS - DAY 46. 14 FEB ZONE INCREMENTAL DAMAGE

(25) *Damage reach 2 summary of calculated damage values by zone for 10 percent chance exceedance event in spring season.*

CROP - WHEAT

(26) ZONE	(26) ELEVATION	(27) DURATION (DAYS)	(28) AREA FLOODED (ACRES)	(29) DAMAGE ($1000)
1	690.0- 696.0	2.64	0.00	0.00
2	696.0- 698.0	2.02	0.00	0.00
3	698.0- 700.0	1.46	0.00	0.00
4	700.0- 702.0	0.80	0.00	0.00
5	702.0- 704.0	0.21	0.00	0.00
6	704.0- 706.0	0.00	0.00	0.00
7	706.0- 708.0	0.00	0.00	0.00
TOTAL			0.00	0.00 (30)

CROP - CORN

ZONE	ELEVATION	DURATION (DAYS)	AREA FLOODED (ACRES)	DAMAGE ($1000)
1	690.0- 696.0	2.64	0.00	0.00
2	696.0- 698.0	2.02	0.00	0.00
3	698.0- 700.0	1.46	0.00	0.00
4	700.0- 702.0	0.80	0.00	0.00
5	702.0- 704.0	0.21	0.00	0.00
6	704.0- 706.0	0.00	0.00	0.00
7	706.0- 708.0	0.00	0.00	0.00
TOTAL			0.00	0.00 (30)

CROP - NO DAMAGE

ZONE	ELEVATION	DURATION (DAYS)	AREA FLOODED (ACRES)
1	690.0- 696.0	2.64	20.00
2	696.0- 698.0	2.02	80.00
3	698.0- 700.0	1.46	300.00
4	700.0- 702.0	0.80	800.00
5	702.0- 704.0	0.21	381.51
6	704.0- 706.0	0.00	0.00
7	706.0- 708.0	0.00	0.00
TOTAL			1581.51 (30)

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

31 *Damage reach 2; 4 percent chance exceedance event damage and area flooded output table.*

DRID - RCH 2
EVENT - 4% CH

TOTAL WEIGHTED EVENT DAMAGE
ALL SEASONS COMBINED ($1000)

	AREA FLOODED (ACRES)	CALCULATED DAMAGE	MULTIFLOOD INCR DAMAGE	INFRA-STRUCTURE DAMAGE	TOTAL DAMAGE
WHEAT	1068.26	31.23	37.48	7.81	76.52
CORN	356.09	17.63	21.16	4.41	43.19
NO DAMAGE	766.96				
TOTAL	2191.30	48.86	58.63	12.22	119.71
	32	33	34	35	36

Several Pages of Output Deleted

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

37 *Damage reach summary output table of damage values by crop category and percent chance exceedance event. Expected annual damage values are also output*

DRID - RCH 2

DAMAGE ($1000) PER FLOOD EVENT

	20% CH	10% CH	4% CH	2% CH	1% CH	EAD*
WHEAT	0.00	50.35	76.52	102.03	109.82	10.26
CORN	0.00	28.27	43.19	57.88	55.08	5.70
TOTAL	0.00	78.63	119.71	159.91	164.89	15.96

* EXPECTED ANNUAL DAMAGE

FREQUENCY-DAMAGE VALUES FOR EACH CROP CATEGORY OUTPUT TO DSS

-----DSS---ZWRITE FILE 71, VERS. 5 /SMITH/RCH 2/FREQ-DAMAGE//1984/NATURAL/

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

DAMAGE REACH 2 SMITH RIVER STUDY

DRID - RCH 2

AREA FLOODED (ACRES) PER FLOOD EVENT

	20% CH	10% CH	4% CH	2% CH	1% CH	EAAF*
WHEAT	0.00	770.99	1068.26	1192.66	1332.45	144.64
CORN	0.00	257.00	356.09	397.55	444.15	48.21
NO DAMAGE	0.00	553.53	766.96	856.27	761.40	101.28
TOTAL	0.00	1581.51	2191.30	2446.49	2538.00	294.14

* EXPECTED ANNUAL AREA FLOODED

38 *Damage reach 2 summary output table of area flooded by crop category and percent chance exceedance event.*

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

TOTAL CROP DAMAGE ($1000) PER FLOOD EVENT FOR ALL REACHES

	20% CH	10% CH	4% CH	2% CH	1% CH	EAD*
WHEAT	0.00	50.35	76.52	102.03	109.82	10.26
CORN	22.43	56.54	86.39	116.43	113.96	12.45
TOTAL	22.43	106.90	162.90	218.46	223.77	22.71

39 *Job summary output table by crop category and percent chance exceedance event. Expected annual damage values are also output.*

* EXPECTED ANNUAL DAMAGE

OUTPUT DISPLAY AND OUTPUT FOR EXHIBIT E-3
AGDAM PROGRAM - TWO CROPS, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY APRIL 1985

TOTAL AREA FLOODED IN ACRES PER FLOOD EVENT FOR ALL REACHES

	20% CH	10% CH	4% CH	2% CH	1% CH	EAAF*
WHEAT	0.00	770.99	1068.26	1192.66	1332.45	144.64
CORN	180.00	513.99	712.17	820.29	968.80	105.35
NO DAMAGE	120.00	691.91	958.70	1083.90	986.25	132.45
TOTAL	300.00	1976.89	2739.13	3096.85	3287.50	382.44

40 *Job summary output table of area flooded by crop category and percent chance exceedance event. Expected annual area flooded values are also output.*

* EXPECTED ANNUAL AREA FLOODED

APPENDIX D

DATA INPUT FROM DSS

APPENDIX D
DATA INPUT FROM DSS

Two basic input options are available for the data needed by the AGDAM program; card (or card image file) input and input from a general purpose random access file. A third option enables card image data defining crop loss function to be read directly from an external file identified as local file 10.

Card input is required for job control, reach analysis specifications, and other data, but random access file retrieval is possible for the basic technical data used in agriculture damage calculations, i.e., area-elevation, discharge-elevation, and hydrograph ordinate values. The general purpose random access file, termed HEC Data Storage System (DSS) provides for an automatic linkage of elevation-area functions from Damage Reach Stage-Damage Calculation-DAMCAL), elevation-flow functions (from Water Surface Profiles-HEC-2) and flow-frequency functions (from Flood Hydrograph Package-HEC-1) to the AGDAM program for damage analysis. These data may be input directly to the DSS by conventional means using DSS utility programs if the programs HEC-1, HEC-2, and DAMCAL are not used. The DSS means of transferring/managing data is particularly applicable for agricultural flood damage analysis involving large numbers of damage categories, damage reaches and alternative plans. PLEASE NOTE: The DSS system capability is presently operational on only Corps supported computer systems.

The DSS is a random access file which enables the automatic interface of analysis programs via exchange of information (input-output) through use of a computer storage device (magnetic disk). The output storage and retrieval of data utilizes a unique classification scheme, termed "pathname", of each data set. Application of DSS is designed to minimize the effort of the user in transferring data from one analysis state (e.g., hydrology) to damage computations. It also provides for some utility/file management of the basic evaluation data.

Figure 2.2, page 6, shows the concept of using the DSS in performing agricultural flood damage assessments. Analyses for flood runoff (HEC-1), yielding frequency curves, rating functions (HEC-2), and elevation-area functions (DAMCAL) are specified for automatic output to the DSS. These data are subsequently accessed by the AGDAM program to perform evaluations of expected annual damage and area flooded. The entire process may be performed in stages by the various disciplines (normal situation for project studies), or performed as linked programs for a single program execution.

The DSS system makes use of a "pathname" to establish the hierarchy of the random access file. The pathname consists of a unique hierarchical labeling scheme for each data set. Information stored in the DSS by an analysis program using a specific pathname may be accessed by a different program using the same pathname. Figure D.1 depicts this concept for elevation-area data. In this schematic, four levels of the pathname are required to uniquely define the elevation-damage functions for each damage reach. They are: (1) the project name (James River), (2) the location name (Damage Reach 10), (3) the variable (elevation-function), (4) BLANK (field omitted), (5) Data Year, and (6) the alternative name (existing conditions). For this example, the pathname may be written as:

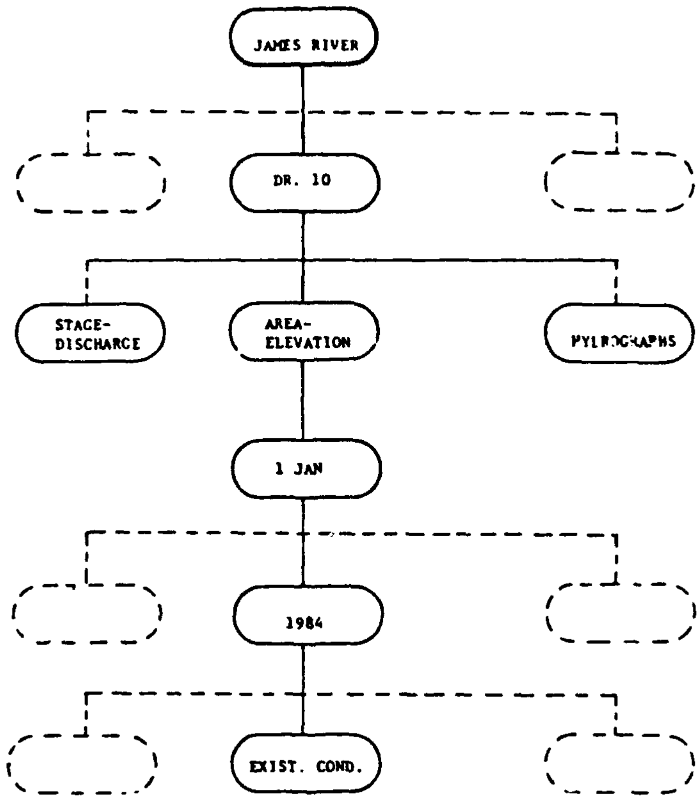
/Project name/location/variable//data year/alternative name/

/JAMES RIVER/DR10/ELEVATION-AREA//1984/EXISTING CONDITIONS/

The DSS enables the pathname to include up to six levels of identifiers. The AGDAM, EAD, DAMCAL, SID, HEC-1, and HEC-2 programs presently use only the 5 levels shown between the slash marks.

Different locations and/or assessments of other alternative plans would subsequently have different pathnames. Retrieval of the elevation-damage functions for input into AGDAM from the DSS would require the use of the exact same pathnames as that of the data sets desired. Other data sets stored in DSS have variations to the pathname so each set is uniquely labeled and retrievable. To the extent possible, interface of the analysis programs

PATHNAME PART	VARIABLE LOCATION
A. PROJECT NAME	A. ZN.1-ZN.2 ZR.1-ZR.2 ZC.1-ZC.1 ZH.1-ZH.1
B. LOCATIONS (Damage Reaches)	B. DR.1 ZN.3-ZN.4 ZR.3-ZR.4 ZC.3-ZC.4 ZH.3-ZH.4
C. VARIABLES	C. DR.2 DR.3 QD.6
D. BEGINNING DATE OF HYDROGRAPHS	D. (Performed internally by program)
E. YEAR OF PLAN	E. ZN.7-ZN.8 ZR.7-ZR.8 ZC.7-ZC.8 ZH.7-ZH.8
F. PLAN	F. ZN.9-ZN.10 ZR.9-ZR.10 ZC.9-ZC.10 ZH.9-ZH.10



PATHNAME

/PART A/PART B/PART C/PART D/PART E/PART F/
/PROJECT NAME/LOCATION/VARIABLES/HYDROGRAPH DATE/YEAR/PLAN/
/JAMES RIVER/DR. 10/AREA-ELEVATION/1 JAN/1984/EXIST. COND./

with DSS (using the pathname concepts) have been made transparent to the user. Prior to the initiation of production executions of the programs, the user must know the elements of the pathname for the data stored in the DSS. Therefore, this requires an initial understanding of the procedures and an agreement on cataloging of alternative plan names, station names, etc., by the study participants prior to the initiation of production oriented evaluations. While this might seem somewhat burdensome at first, it is a good study management practice for any type of evaluation.

The insertion of the ZN card flags the use of the DSS during the job. The ZN card also establishes the project, data year, and alternative name portions of the pathname for output frequency-damage data to the DSS and EAD program. The ZR, ZC, and ZH cards specify portions of pathnames required to retrieve discharge-elevation, elevation-area, and hydrograph ordinates, respectively, from the DSS.

The following paragraphs outline user considerations relevant to using the DSS.

- The station names, pathname location component, (control points, damage reaches, subbasins, etc.) should have been chosen carefully, and, if possible, be recognizable locations. The location names used by the programs may be any combination of alphanumeric values except for slashes which are reserved for program usage. The names must be exact for storing and retrieval of the same data set. Leading and trailing blanks are ignored but blanks within the name are considered part of that name.

- Flexibility has been incorporated into the programs to enable the location name of the data set to be modified and stored in the DSS as a different location name.

- On some computer systems, (where multiple access is not allowed) to avoid two programs updating the same DSS file simultaneously and potentially having an unrevised data set, any execution of a program using the DSS should include job control language to lock out others until the execution is completed.

- Execution of a program which writes to the DSS with the exact pathname as a previous execution will write over and eliminate the previous data from any subsequent processing.

The DSS has utility programs available for manipulating the information and pathnames stored. The programs enable editing of information, changing pathnames, purging unwanted data sets and insertion of other data sets. Graphic output is also available for DSS data. The interested user is encouraged to contact HEC for up-to-date information and documentation on the DSS and companion utility programs. It should be emphasized, however, that users wishing to use the DSS with EAD (or HEC-1, HEC-2 or SID) need not be familiar and proficient with all the intricacies of the general purpose system. Study of the examples in SID, herein, and minimal DSS familiarity should suffice for the average user.

APPENDIX E

TEST PROBLEMS

APPENDIX E
TEST PROBLEMS

1.0 Purpose and Overview

The test problems of this Appendix are included to illustrate selected capabilities, input requirements, and output format of the Agricultural Flood Damage Analysis (AGDAM) program. The problems are also intended for use in verification of distributed program code. Three problems are presented:

- Exhibit E-1. This Exhibit presents a manual computation of agricultural crop damage of a 20 percent chance exceedance flood event. The problem scope is limited (one crop, one reach, four seasons) to assist users in understanding the computation procedures.

- Exhibit E-2. This Exhibit is a computer execution of Exhibit E-1 problem.

- Exhibit E-3. This problem expands on Exhibit E-2 by using two reaches, two crops, and the multiflood and infrastructure damage adjustment factors. Job summary outputs are also depicted.

EXHIBIT E-1

MANUAL FLOOD DAMAGE CALCULATIONS -

SINGLE CROP AND SINGLE REACH

EXHIBIT E-1

MANUAL FLOOD DAMAGE CALCULATION -

SINGLE CROP AND SINGLE REACH

1.0 PURPOSE

This hand computation example illustrates the primary analysis procedures of AGDAM computer program. The number of variables (seasons, flood hydrograph ordinates, events, and crop categories) are minimized to simplify the computations and thus more clearly demonstrate basic data requirements and analysis procedures. The example is a manual calculation of the crop damage associated with a specific (20 percent chance exceedance) flood event. Figure E-1 depicts the study area, the Smith River.

2.0 PROBLEM

Calculate the damage to corn in reach one that would result from the 20 percent exceedance flood event. Base the calculations on four seasons - winter, spring, summer and fall.

3.0 BASIC DATA REQUIREMENTS

Previous studies in the Smith River basin have generated the basic economic damage and hydrologic data needed for the analysis. The information includes: elevation-agricultural area relationships; crop composition of the agricultural area of the reach; crop values; and damage potential functions derived from crop budget assessments.

3.1 Elevation-Agricultural Area Relationship

The water surface profile elevation-agricultural crop area relationship for Reach 1 is shown in Table E1.1. The area was obtained from planimetering topographic maps of the reach considering slope in water surface profiles. Aerial photographs and field reconnaissance were used to determine proportions of the total area that were cropped.

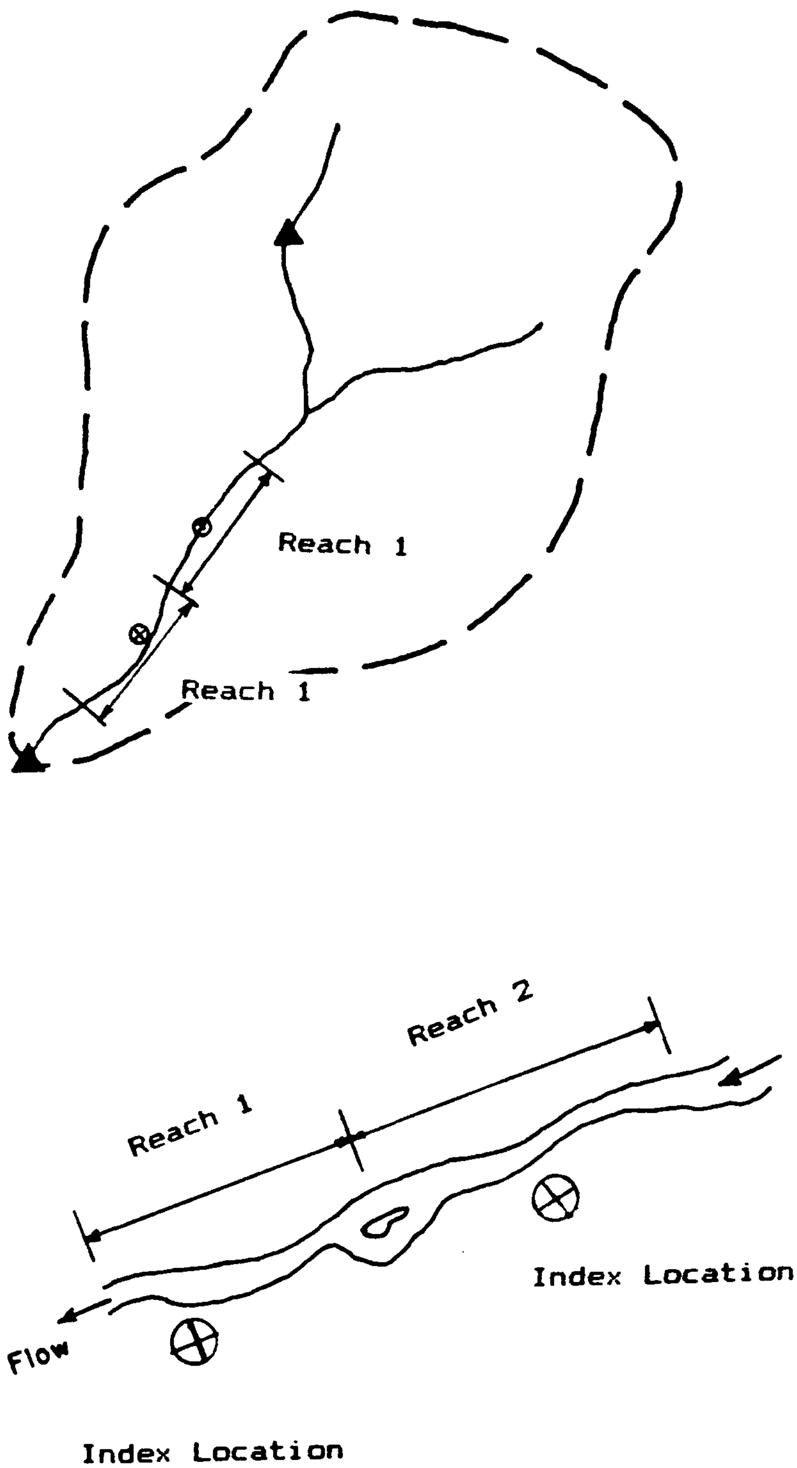


Figure E1.1 SMITH RIVER BASIN

TABLE E1.1

ELEVATION - AGRICULTURAL AREA RELATIONSHIPS

Elevation M.S.L.	Agricultural Area (acres)
694	0
700	10
702	50
704	200
706	600
708	1200
710	2500
712	5000

3.2 Crop Value Per Acre

The crop composition of Reach 1 was detemined via field reconnaissance, interviews of local farmers, and inspection of aerial photographs for selected time periods over the past two decades. Corn comprises about 50 percent of the agricultural area with the remainder in wheat and soybeans. The estimated yields, prices, and values per acre of the crops are shown in Table E1.2.

TABLE E1.2

CROP DATA

CROP	PERCENT AGRICULTURAL OF AREA	YIELD (BUSHELS) PER ACRE	PRICE PER UNIT	VALUE PER ACRE
Corn	50	110	$2.[illegible]5	$302.50
Wheat	25	45	3.25	146.25
Soybeans	25	25	5.00	125.00

3.3 Crop Loss Functions

Crop loss functions for corn were derived from literature review and interviews with farmers and other agricultural related business persons. The

functions were derived from investment costs, profits, and critical dates of the year. Critical dates include: the start of soil preparation, end of cultivation, crop maturity, and beginning and ending of harvest. Based on these data, a relationship of percent loss as a function of the gross value minus harvest costs (100 percent) was developed for days of the year (Figure E1.2). This relationship represents the maximum potential loss for a given date. Duration-damage tables (percent loss of the maximum potential loss) were also developed to account for the effects of various flood durations. These relationships are tabulated in Table E1.3.

The actual value of potential crop loss was determined by multiplying the value per acre of corn (302.50 from Table E1.2) times the percent values of Table E1.3. Table E1.4 tabulates the calculated dollar loss values for corn.

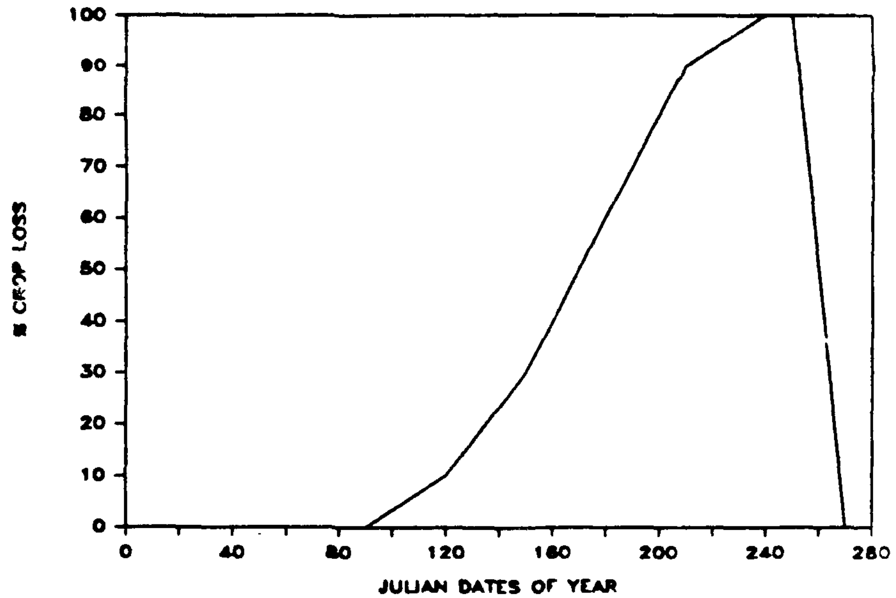


FIGURE E1.2 CROP LOSS FUNCTION

TABLE E1.3

CROP (CORN) LOSS PER ACRE

FOR SELECTED FLOOD DURATIONS

(PERCENT LOSS VALUES)

DATE	DAY OF YEAR	POTENTIAL PERCENT LOSS(CORN)	PERCENT LOSS BY FLOOD DURATION (DAYS) 0-DAY	1-DAY	3-DAYS	7-DAYS
31 Mar	90	0	0	0	0	0
30 Apr	120	10	0	10	30	40
30 May	150	30	0	50	70	80
29 Jul	210	90	0	60	90	100
28 Aug	240	100	0	80	100	100
7 Sep	250	100	0	80	100	100
27 Sep	270	0	0	80	100	100

[1]From Figure E1.2 for corresponding Julian Date.

TABLE E1.4

CROP LOSS PER CORN ACRE

FOR SELECTED FLOOD DURATIONS

(DOLLAR LOSS VALUE)

DATE	DAY OF YEAR	POTENTIAL PERCENT LOSS	PERCENT LOSS BY FLOOD DURATION (DAYS) 0-DAY	1-DAY	3-DAYS	7-DAYS
31 Mar	90	0	0	0	0	0
30 Apr	120	$ 30.25	0	3.02	9.07	12.10
30 May	150	90.75	0	45.38	63.52	72.60
29 Jul	210	272.25	0	163.35	245.02	272.25
28 Aug	240	302.50	0	242.00	302.50	302.50
7 Sep	250	302.50	0	242.00	302.50	302.50
27 Sep	270	0	0	0	0	0

3.4 Seasonal Data

Seasonal periods used in the determination of event damage were defined based on inspection of the crop loss function and hydrologic runoff

characteristics throughout the year. The proportion of time the event occurs in each season was estimated from review of nearby streamgage records. Table E1.5 shows the seasons used (winter, spring, summer and fall) and proportion of time the 20, 4, and 1 percent exceedance events occur in each season.

TABLE E1.5
PROPORTIONS OF TIME
EVENT OCCURS BY SEASONS

SEASON	PERIOD OF YEAR (DAY)	PROPORTION OF TIME EVENT OCCURS IN SEASON 20% EVENT	4% EVENT	1% EVENT
Winter	1- 90	10	05	05
Spring	90-180	40	50	50
Summer	180-270	20	15	15
Fall	270-365	30	30	30

3.5 Discharge - Elevation Data

A rating curve (discharge-elevation relationship) was determined from analysis of a range of water surface profiles at the damage reach index location. Table E1.6 shows the rating curve determined in the profile analysis.

TABLE E1.6
RATING CURVE

ELEVATION FT (M.S.L.)	DISCHARGE C.F.S.
694.0	0
700.0	150
702.0	540
704.0	1,400
706.0	2,700
708.0	5,000
710.0	15,000
712.0	80,000

3.6 Discharge Hydrographs

A set of flood hydrographs for the Smith River watershed at the damage reach index location was developed using rainfall-runoff analysis procedures. The hydrographs were calculated at upstream subbasin outlets and combined and routed through the system. The analysis included calibration of hydrologic parameters, frequency discharge, and volume values to historic events and records. Since damage to crops does not occur during the winter (snowmelt runoff) season, the rainfall set of hydrographs were assumed applicable for all seasons. Table E1.7 shows the 20, 4, and 1 percent exceedance frequency hydrographs developed from the rainfall-runoff analysis.

TABLE E1.7
DISCHARGE HYDROGRAPHS
(ALL SEASONS)

TIME (HRS.)	20% EVENT C.F.S.	4% EVENT C.F.S.	1% EVENT C.F.S.
0	0	0	0
12	1000	1700	2800
24	2700	4600	7300
36	1300	3200	5500
48	200	1100	3300
60	0	200	1700
72	0	0	500
84	0	0	0

4.0 DAMAGE CALCULATION PROCEDURES

The damage analysis of corn from a 20 percent chabce exceedance event requires development of the damage potential for each season, calculation of the actual damage by flood events and seasons, and determinaion of the total event damage from the weighted seasonal values.

4.1 Elevation Based Hydrographs

The conversion of discharge hydrographs to elevation based hydrographs is required to enable calculation of duration of flooding by flood zones. Elevation values for the 20 percent chance exceedance hydrograph of Table E1.6 were interpolated linearly from the rating curve of Table E1.5. The resulting 20 percent chance exceedance event elevation hydrograph is shown in Table E1.7.

TABLE E1.8

20% EXCEEDANCE FREQUENCY EVENT ELEVATION HYDROGRAPH

(ALL SEASONS)

TIME (HRS.)	DISCHARGE (CFS)	ELEVATION (FT. M.S.L.)
0	0	694.0
12	1000	703.1
24	2700	706.0
36	1300	703.8
48	200	700.3
60	0	694.0

4.2 Duration of Flooding By Zones

Flood zones are used to calculate damage potential that results from different durations of flooding throughout the elevation range. Table E1.9 illustrates the zone-duration of flooding calculations.

4.2.1 20 Percent Exceedance Frequency Event. The peak 20 percent exceedance frequency discharge from Table E1.8 is 2700 c.f.s., which corresponds to an elevation of 706.0 feet m.s.l. Therefore, the range of damage potential for corn is from elevation 694.0 to 706.0 feet m.s.l. The division of zones is based on the elevation values of Table E1.5. The flood zones for analysis are as shown in Table E1.9.

TABLE E1.9

FLOOD ZONES

20 PERCENT CHANCE EXCEEDANCE EVENT

ZONE	ELEVATION RANGE FEET M.S.L
1	694.0 - 700.0
2	700.0 - 702.0
3	702.0 - 704.0
4	704.0 - 706.0

For this example the cropping pattern of corn is assumed to start at the invert (zero discharge) of the channel or conveyance path. The more typical situation would be for the start of planting to be above the high bank of the channel.

(a) Zone 1 Duration. The duration of flooding of zone 1 is assumed to be the average duration over the zone. This is determined by averaging the duration of flooding at the lower and upper elevation limits of the zone, 694.0 and 700.0, respectively. A small discharge is assumed at the lower limit, elevation 694.0, which therefore results in a duration of 60 hours or 3600 minutes (see Figure E1.3). The upper limit duration is 60 hours less the time rising limb time (T_1) and the receding limb time (T_2). The duration calculations for the upper limit (elevation 700.0) is described in subsequent paragraphs.

The rising limb time is calculated in minutes based on the interpolation of time and discharge values. From Table E1.5 the discharge at elevation 700.0 ft. m.s.l. is 150 c.f.s. The discharge from Table E1.6 at 12 hours is 1000 c.f.s. Therefore:

$$\frac{T_1 \text{ (minutes)}}{12 \text{ hrs} \times 60 \text{ min/hr}} = \frac{150 \text{ cfs} - 0 \text{ cfs}}{1000 \text{ cfs} - 0 \text{ cfs}}$$

$$T_1 = \frac{150}{1000} \times 720$$

$$T_1 = 108 \text{ minutes or } 1.80 \text{ hours}$$

(b) Similarly, the value (T_2) associated with the recession limb of the 20 percent chance exceedance event may be estimated by interpolating linearly data obtained from Tables E1.6 and E1.7, and shown in Figure E1.3.

$$\frac{T_2}{150 \text{ cfs}} = \frac{60 \text{ min/hr } (60 \text{ hrs} - 48 \text{ hrs})}{200 \text{ cfs}}$$

T_2 = 540 minutes or 9 hours

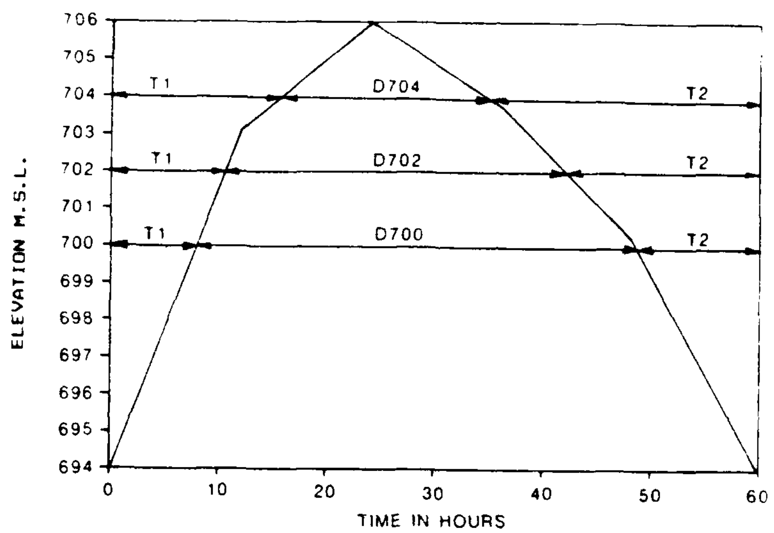


FIGURE E1.3 ELEVATION HYDROGRAPH

(c) The duration of flooding at elevation 700.0 therefore may be estimated as:

$$D_{700} = ((60 \text{ hrs} - T_1 - T_2) + 60 \text{ hrs})/2$$
$$= ((60 \text{ hrs} - 9 \text{ hrs} - 1.80 \text{ hrs}) + 60 \text{ hrs})/2$$
$$= 54.60 \text{ hrs or } 2.275 \text{ days}$$

Note: The linear interpolation is performed on discharge not elevation values.

(d) Similar calculations can be performed for the other flood zones. The results are summarized in Table E1.10.

4.3 Damage Calculations

Damage calculations are performed using the crop loss per acre relationships in Table E1.4 for the seasons shown in Table E1.5. Damage calculations for the winter season were not required because no damage occurs between Julian days 1 and 90.

4.3.1 Zone 1 Damage, 20 Percent Chance Exceedance Event. The damage calculations of the spring season are performed by evaluating the damage potential between Julian days 90 and 180. The average day of the spring season is therefore equal to Julian day 135.

a. The maximum damage (MAXDAM) to the corn crop that could occur may be determined from interpolation of the Julian day and potential dollar loss values of Table E1.4. Where:

$$\frac{(\text{MAXDAM} - \$30.25)}{(\$90.75 - \$30.25)} = \frac{\text{Julian Days } (135 - 120)}{\text{Julian Days } (150 - 120)}$$

$$\begin{aligned} \text{MAXDAM} &= .50(\$90.75 - 30.25) + 30.25 \\ &= \$60.50 \end{aligned}$$

b. The 20 percent chance exceedance event damage per acre for zone 1 (2.275 days duration of flooding) may be estimated from interpolation of one and three days duration damage potential for Julian day 135 as shown in Table E1.4.

(1) Damage of one day duration flooding (D_1) for Julian day 135 may be determined by the following interpolation.

$$\frac{(D_1 - \$3.02)}{(\$45.38 - \$3.02)} = \frac{\text{Julian Days } (135\text{-}120)}{\text{Julian Days } (150\text{-}120)}$$

$$D_1 = .5(\$45.38 - \$3.02) + \$3.02$$
$$D_1 = \$24.20/\text{acre}$$

(2) Damage at Julian day 123 for 3 days duration of flooding (D_3) is determined in a similar manner as for the one day duration.

$$\frac{(D_3 - \$9.07)}{(\$63.52 - \$9.07)} = \frac{\text{Julian Days (135-120)}}{\text{Julian Days (150-120)}}$$

$$D_3 = .5(\$63.52 - \$9.07) + \$9.07$$
$$= \$36.29/\text{acre}$$

(3) The dollar damage per acre of corn for the spring season may be subsequently determined by interpolation of the values for 1 and 3 days duration of flooding.

$$\frac{(D_{2.275} - \$24.20)}{(\$36.29 - \$24.20)} = \frac{(2.275 - 1)\text{ days}}{(3-1)\text{ days}}$$

$$D_{2.275} = (1.275/2)(\$36.29 - \$24.20) + \$24.20$$
$$D_{2.275} = \$31.91/\text{acre}$$

(4) Damage to the corn crop for zone 1 may be calculated as

$$D = (31.91/\text{acre})(5\text{ acres}) - (\$10/\text{acre harvest costs})(5\text{ acres})$$
$$D = \$109.55/\text{acre}$$

Similar calculations may be performed for other zones and seasons. Table E1.10 depicts the results of the computations. The zone values are summed to get a total damage by season. The values must subsequently be weighted by the proportion of time the 20 percent exceedance event occurs in each season. The sum of the weighted seasonal damage values produce the total crop damage for the 20 percent event. Weighted value computations are illustrated in Table E1.10.

TABLE E1.10

20% CHANCE EXCEEDANCE EVENT DAMAGE TO CORN

CALCULATION SUMMARY

ZONE	ELEVATION RANGE	FLOOD DUR. DAYS	DAMAGE BY SEASONS ($1000) WINTER	SPRING	SUMMER	FALL
1	694-700	2.27	0	.11	.11	0
2	700-702	1.81	0	.39	3.85	0
3	702-704	1.21	0	1.22	13.07	0
4	704-706	.42	0	1.28	14.22	0
5	706-708	0	0	0	0	0
				$2.99	$32.16	0

20% CHANCE EXCEEDANCE EVENT DAMAGE = Calculated Season Damage x Seasonal Weightings

= ($2.99) (.40) + ($32.16) (.20)

= $7.63 (1000)

= $7630.00

EXHIBIT E-2

AGDAM SINGLE CROP, SINGLE REACH,

FLOOD DAMAGE COMPUTATIONS

EXHIBIT E-2

AGDAM FLOOD DAMAGE COMPUTATIONS - SINGLE CROP AND SINGLE REACH

This example uses the Smith River input data described in Exhibit E-1 to calculate expected annual damage and area flooded for a single crop and reach. Included as part of the analysis is the 20 percent chance exceedance event flood damage manually calculated in Exhibit E-1. Specific analyses are:

- Calculation of the 20, 4, and 1 percent chance exceedance year event flood damage to corn in reach one;

- Calculation of the 20, 4, and 1 percent chance exceedance event area flooded to corn in reach one; and

- Calculation of expected annual damage to corn and area flooded to corn in reach one.

- The analyses are performed using four seasons labeled winter, spring, summer and fall.

Only selected output pertinent to desired operations and displays is shown on following pages.

```
T1              EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
T2              AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
T3              SMITH RIVER STUDY              SEPTEMBER 1984
J1
CR  CORN     110  BUSHEL    2.75             180     250     260      50
CT    90     120     150     210     240     250     270
CB     0     .10     .30     .90    1.00    1.00       0
CD     0       1       3       7
C1     0       0       0       0       0       0       0
C2     0      .1      .5      .6      .8      .8      .8
C3     0      .3      .7      .9     1.0     1.0     1.0
C4     0      .4      .8     1.0     1.0     1.0     1.0
SN        WINTER          SPRING          SUMMER          FALL
SD     1      90     180     270
FT20% CH  5% CH   1% CH
FR    20       4       1
P1    10      40      20      30
P2     5      50      15      30
P3     5      50      15      30
DR RCH 1                             1.0
DT              DAMAGE REACH 1  SMITH RIVER STUDY
EV   694     700     702     704     706     708     710     712
QQ     0     150     540    1400    2700    5000   15000   80000
EL   694     700     702     704     706     708     710     712
AR     0      10      50     200     600    1200    2500    5000
CP  CORN      50
QD RCH 1              10     720       1
HQ
HF   0.2    0.04    0.01
H1     0    1000    2700    1300     200       0
H2     0    1700    4600    3200    1100     200       0
H3     0    2800    7300    5500    3300    1700     500       0
EJ
```

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY   SEPTEMBER 1984

```
   J1 CARD - JOB SPECIFICATIONS
CC 1234567890123456789012345678901234567890123456789012345678901234567890
   J1

   IMAGE  =          0 INPUT LINE IMAGES AND VARIABLE VALUES WILL BE PRINTED
   IPRINT =          0 PRINT CROP BUDGET & LOSS TABLE, EVENT TABLE, CROP AREA TABLE AND
                       DAMAGE TABLES FOR ZONE, SEASON, EVENT, REACH AND RUN
   PINDEX =       1.00 PRICE INDEX FACTOR
   INFRAS =       0.00 INFRASTRUCTURE DAMAGE FACTOR
   MULTFD =       0.00 MULTI-FLOOD ADJUSTMENT FACTOR
   DSSOUT =          0 NO DSS OUTPUT WILL BE WRITTEN
   CRFILE =          0 CROP DATA READ FROM INPUT DECK
```

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

```
   CR CARD - CROP DEFINITION
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   CR  CORN     110  BUSHEL    2.75              180      250      260      50

   CRPTIT =      CORN CROP NAME
   CYA    =    110.00 CROP YIELD PER UNIT AREA
   CUNIT  =    BUSHEL UNITS OF YIELD
   CUP    =      2.75 UNIT PRICE
   MULTFL =      0.00 MULTI-FLOOD ADJUSTMENT FACTOR
   ICULT  =       180 DATE OF START OF CULTIVATION
   IMATUR =       250 DATE OF CROP MATURITY
   IHRVST =       260 DATE OF START OF HARVEST
   HRVCST =     50.00 HARVEST COST $ PER ACRE


   CT CARD - DAMAGE, BUDGET DATE ARRAY
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   CT    90      120      150      210      240      250      270

   CB CARDS - CROP BUDGET ARRAY
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   CB     0      .10      .30      .90     1.00     1.00        0

   CD CARDS - CROP FLOODING DURATION ARRAY
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   CD     0        1        3        7

   C1 CARDS - % CROP LOSS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   C1     0        0        0        0        0        0        0

   C2 CARDS - % CROP LOSS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   C2     0       .1       .5       .6       .8       .8       .8

   C3 CARDS - % CROP LOSS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   C3     0       .3       .7       .9      1.0      1.0      1.0

   C4 CARDS - % CROP LOSS
CC 12345678901234567890123456789012345678901234567890123456789012345678901234567890
   C4     0       .4       .8      1.0      1.0      1.0      1.0
```

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

```
CRPTIT =      CORN CROP NAME
CYA    =    110.00 YIELD PER UNIT AREA
CUNIT  =    BUSHEL UNITS OF YIELD
CUP    =      2.75 UNIT PRICE
MULTFL =      0.00 MULTI-FLOOD ADJUSTMENT FACTOR
ICULT  =       180 DATE OF START OF CULTIVATION
IMATUR =       250 DATE OF CROP MATURITY
IHRVST =       260 DATE OF START OF HARVEST
HRVCST =     50.00 HARVEST COST $ PER ACRE
```

CROP LOSS TABLE (PERCENT LOSS VALUES)

DATE	DAY OF YEAR	POTENTIAL LOSS (%)	0.0	PERCENT LOSS BY FLOOD DURATION (DAYS) 1.0	3.0	7.0
31 MARCH	90.	0.0	0.0	0.0	0.0	0.0
30 APRIL	120.	10.0	0.0	10.0	30.0	40.0
30 MAY	150.	30.0	0.0	50.0	70.0	80.0
29 JULY	210.	90.0	0.0	60.0	90.0	100.0
28 AUG	240.	100.0	0.0	80.0	100.0	100.0
7 SEPT	250.	100.0	0.0	80.0	100.0	100.0
27 SEPT	270.	0.0	0.0	80.0	100.0	100.0

CROP LOSS TABLE (DOLLAR LOSS VALUES)

DATE	DAY OF YEAR	POTENTIAL LOSS ($)	0.0	DOLLAR LOSS BY FLOOD DURATION (DAYS) PER ACRE 1.0	3.0	7.0
31 MARCH	90.	0.00	0.00	0.00	0.00	0.00
30 APRIL	120.	30.25	0.00	3.02	9.07	12.10
30 MAY	150.	90.75	0.00	45.38	63.52	72.60
29 JULY	210.	272.25	0.00	163.35	245.02	272.25
28 AUG	240.	302.50	0.00	242.00	302.50	302.50
7 SEPT	250.	302.50	0.00	242.00	302.50	302.50
27 SEPT	270.	0.00	0.00	0.00	0.00	0.00

Several Pages of Output Deleted

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

EVENT WEIGHTINGS BY SEASON
PROPORTION OF TIME FREQUENCY EVENT OCCURS IN EACH SEASON

SEASON	EVENT % CHANCE EXCEEDANCE VALUES		
	20.00	4.00	1.00
WINTER	10.00	5.00	5.00
SPRING	40.00	50.00	50.00
SUMMER	20.00	15.00	15.00
FALL	30.00	30.00	30.00

Several Pages of Output Deleted

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

CROP AREA (ACRES)

ZONE	ELEVATION	TOTAL AREA	CORN
1	694.0- 700.0	10.0	5.0
2	700.0- 702.0	50.0	25.0
3	702.0- 704.0	200.0	100.0
4	704.0- 706.0	600.0	300.0
5	706.0- 708.0	1200.0	600.0
6	708.0- 710.0	2500.0	1250.0
7	710.0- 712.0	5000.0	2500.0

Several Pages of Output Deleted

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

INPUT SEASONAL HYDROGRAPHS

WINTER
SPRING
SUMMER
FALL

INPUT EVENT % CHANCE EXCEEDANCE VALUES

TIME-HRS	20.00	4.00	1.00
0.00	0.00	0.00	0.00
12.00	1000.00	1700.00	2800.00
24.00	2700.00	4600.00	7300.00
36.00	1300.00	3200.00	5500.00
48.00	200.00	1100.00	3300.00
60.00	0.00	200.00	1700.00
72.00	0.00	0.00	500.00
84.00	0.00	0.00	0.00
96.00	0.00	0.00	0.00
108.00	0.00	0.00	0.00

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

SEASONAL HYDROGRAPHS
INTERPOLATED FROM INPUT HYDROGRAPHS

WINTER
SPRING
SUMMER
FALL

JOB EVENT % CHANCE EXCEEDANCE VALUES

TIME-HRS	20.00	4.00	1.00
0.00	0.00	0.00	0.00
12.00	1000.00	1700.00	2800.00
24.00	2700.00	4600.00	7300.00
36.00	1300.00	3200.00	5500.00
48.00	200.00	1100.00	3300.00
60.00	0.00	200.00	1700.00
72.00	0.00	0.00	500.00
84.00	0.00	0.00	0.00

Several Pages of Output Deleted

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1
EVENT - 20% CH
SEASON - SPRING
DATE OF CALCULATIONS - DAY 135. 15 MAY

ZONE INCREMENTAL DAMAGE

CROP - CORN

ZONE	ELEVATION	DURATION (DAYS)	AREA FLOODED (ACRES)	DAMAGE ($1000)
1	694.0- 700.0	2.27	5.00	0.11
2	700.0- 702.0	1.81	20.00	0.39
3	702.0- 704.0	1.21	75.00	1.22
4	704.0- 706.0	0.42	200.00	1.28
5	706.0- 708.0	0.00	0.00	0.00
6	708.0- 710.0	0.00	0.00	0.00
7	710.0- 712.0	0.00	0.00	0.00
TOTAL			300.00	2.99

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1
EVENT - 5% CH
SEASON - SPRING
DATE OF CALCULATIONS - DAY 135. 15 MAY

ZONE INCREMENTAL DAMAGE

CROP - CORN

ZONE	ELEVATION	DURATION (DAYS)	AREA FLOODED (ACRES)	DAMAGE ($1000)
1	694.0- 700.0	2.79	5.00	0.12
2	700.0- 702.0	2.37	20.00	0.44
3	702.0- 704.0	1.83	75.00	1.45
4	704.0- 706.0	1.23	200.00	3.26
5	706.0- 708.0	0.47	247.83	1.78
6	708.0- 710.0	0.00	0.00	0.00
7	710.0- 712.0	0.00	0.00	0.00
TOTAL			547.83	7.06

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1
EVENT - 1% CH
SEASON - SPRING
DATE OF CALCULATIONS - DAY 135. 15 MAY

ZONE INCREMENTAL DAMAGE

CROP - CORN

ZONE	ELEVATION	DURATION (DAYS)	AREA FLOODED (ACRES)	DAMAGE ($1000)
1	694.0- 700.0	3.41	5.00	0.13
2	700.0- 702.0	3.11	20.00	0.51
3	702.0- 704.0	2.63	75.00	1.75
4	704.0- 706.0	2.04	200.00	4.08
5	706.0- 708.0	1.29	300.00	4.98
6	708.0- 710.0	0.43	149.50	0.98
7	710.0- 712.0	0.00	0.00	0.00
TOTAL			749.50	12.44

Several Pages of Output Deleted

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1
EVENT - 20% CH

TOTAL WEIGHTED EVENT DAMAGE
ALL SEASONS COMBINED ($1000)

	AREA FLOODED (ACRES)	CALCULATED DAMAGE	MULTIFLOOD INCR DAMAGE	INFRA-STRUCTURE DAMAGE	TOTAL DAMAGE
CORN	180.00	7.63	0.00	0.00	7.63
NO DAMAGE	120.00				
TOTAL	300.00	7.63	0.00	0.00	7.63

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1
EVENT - 5% CH

TOTAL WEIGHTED EVENT DAMAGE
ALL SEASONS COMBINED ($1000)

	AREA FLOODED (ACRES)	CALCULATED DAMAGE	MULTIFLOOD INCR DAMAGE	INFRA-STRUCTURE DAMAGE	TOTAL DAMAGE
CORN	356.09	14.69	0.00	0.00	14.69
NO DAMAGE	191.74				
TOTAL	547.83	14.69	0.00	0.00	14.69

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1
EVENT - 1% CH

TOTAL WEIGHTED EVENT DAMAGE
ALL SEASONS COMBINED ($1000)

	AREA FLOODED (ACRES)	CALCULATED DAMAGE	MULTIFLOOD INCR DAMAGE	INFRA-STRUCTURE DAMAGE	TOTAL DAMAGE
CORN	487.17	25.07	0.00	0.00	25.07
NO DAMAGE	262.32				
TOTAL	749.50	25.07	0.00	0.00	25.07

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1

DAMAGE ($1000) PER FLOOD EVENT

	20% CH	5% CH	1% CH	EAD*
CORN	7.63	14.69	25.07	2.50
TOTAL	7.63	14.69	25.07	2.50

* EXPECTED ANNUAL DAMAGE

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

DAMAGE REACH 1 SMITH RIVER STUDY

DRID - RCH 1

AREA FLOODED (ACRES) PER FLOOD EVENT

	20% CH	5% CH	1% CH	EAAF*
CORN	180.00	356.09	487.17	58.08
NO DAMAGE	120.00	191.74	262.32	33.28
TOTAL	300.00	547.83	749.50	91.36

* EXPECTED ANNUAL AREA FLOODED

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

TOTAL CROP DAMAGE ($1000) PER FLOOD EVENT FOR ALL REACHES

	20% CH	5% CH	1% CH	EAD*
CORN	7.63	14.69	25.07	2.50
TOTAL	7.63	14.69	25.07	2.50

* EXPECTED ANNUAL DAMAGE

EXHIBIT E-2 - AGRICULTURAL FLOOD DAMAGE ANALYSIS
AGDAM PROGRAM - SINGLE CROP, FOUR SEASONS, THREE FLOOD EVENTS
SMITH RIVER STUDY SEPTEMBER 1984

TOTAL AREA FLOODED IN ACRES PER FLOOD EVENT FOR ALL REACHES

	20% CH	5% CH	1% CH	EAAF*
CORN	180.00	356.09	487.17	58.08
NO DAMAGE	120.00	191.74	262.32	33.28
TOTAL	300.00	547.83	749.50	91.36

* EXPECTED ANNUAL AREA FLOODED

EXHIBIT E-3

AGDAM FLOOD DAMAGE COMPUTATIONS -
TWO CROPS AND TWO REACHES

EXHIBIT E-3

AGDAM FLOOD DAMAGE COMPUTATIONS - TWO CROPS AND TWO REACHES

This example expands on the Smith River problem presented in Exhibits E-1 and E-2 by performing damage and area flooded calculations for two crops and two damage reaches. Specific analyses are:

- The use of interpolated hydrographs (FR card) to analyze the 20, 10, 4, 2, and 1 percent chance exceedance flood events;
- Calculation of expected annual damage to corn and area flooded in reach one and to corn and wheat in reach two; and
- The use of multiflood and infrastructure adjustment factors to the calculated damage.

Appendix C illustrates selected output from this example problem.

APPENDIX F

INPUT DESCRIPTION

APPENDIX F
INPUT DESCRIPTION

Paragraph Number	Card	Description	Page
1.0		INPUT DESCRIPTION	F-2
2.0		JOB TITLE CARDS	F-2
2.1	T1-T3 (required)	Title cards defining job	F-2
3.0		JOB CARDS	F-3
3.1	J1 (required)	Specifies job input-output and analysis	F-3
3.2	ZN (optional)	Job card required if DSS is to be used	F-5
4.0		CROP CARDS	F-5
4.1	CR (required)	Specifies job crop type, unit price, yield	F-6
4.2	CT (required)	Julian days of year	F-7
4.3	CB (required)	Crop loss function	F-7
4.4	CD (required)	Duration-damage output titles	F-8
4.5	C1-C6 (required)	Duration-damage relationships	F-8
5.0		SEASON CARD	F-9
5.1	SN (required)	Specifies seasons to be analyzed	F-10
5.2	SD (required)	Julian dates of seasons	F-10
6.0		EVENT FREQUENCY CARDS	F-11
6.1	FT (required)	Event-frequency titles	F-11
6.2	FR (required)	Exceedance frequency of events to be analyzed	F-12
6.3	P1-P9 (required)	Event weighting assignments by seasons	F-13
7.0		DAMAGE REACH CARDS	F-14
7.1	DR (required)	Damage reach analyses specifications	F-14
7.2	DT (required)	Damage reach title	F-15
7.3	EV (optional)	Elevations for rating curve	F-16
7.4	QQ (optional)	Discharge values for rating curve	F-16
7.5	ZR (optional)	Rating curve from DSS	F-17
7.6	EL (optional)	Elevation cards for corresponding areas	F-18
7.7	AR (optional)	Total crop area corresponding to elevations	F-18
7.8	CP (required)	Crop data for reach	F-19
7.9	CA (optional)	Individual crop area values	F-20
7.10	ZC (optional)	Crop area from DSS	F-21
8.0		HYDROLOGIC DATA CARDS	F-22
8.1	QD (required)	Reach hydrograph specifications	F-22
8.2	HQ (required)	Hydrograph season specifications	F-23
8.3	HF (optional)	Input hydrograph frequency values	F-24
8.4	H1-H9 (optional)	Hydrograph ordinates	F-24
8.5	ZH (optional)	Hydrograph ordinates from DSS	F-26
9.0		END OF JOB CARD	F-26
9.1	EJ (required)	Designates end-of-job	F-26

APPENDIX F
INPUT DESCRIPTION

1.0 INPUT DESCRIPTION

This exhibit provides a detailed description of the Agricultural Flood Damage Analysis (AGDAM) program data input requirements, by card and data variable. The field number designates the location of the variables on each input card. Card columns 1-2 are reserved for the card identifiers and are referred to as field 0 (zero). Field 1 ranges from card columns 3-8; fields 2-10 contain eight columns each. The card name is followed by a decimal point and the field number. For example, DC.8 refers to the eighth field on the DC card. A "+" sign under the heading indicates the placement of a positive numerical value in that field. A "-" sign indicates a negative numerical value in that field. "AN" means that a combination of alphanumeric characters is allowed. When a number does not have a sign, a positive value will be assumed. Blank numerical fields are assumed equal to zero. In general, input values, both numerical and alphanumeric, should be right-justified in their fields except for multiple field alphanumeric information.

2.0 TITLE CARDS

2.1 T1, T2, T3 CARDS

The required T cards provide three lines of information at the top of each page of output.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	T1,T2,T3	Card identification (3 cards).
1-10	TITLE	AN	Title information (center of title falls in card column 41).

APPENDIX F
INPUT DESCRIPTION

3.0 JOB CARDS

3.1 J1 CARD - JOB CARD

The required J1 card specifies the analysis to be performed and options for input listings and printout.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	J1	Card identification.
1	IMAGE	0	Listing of card input sequence and input variable values will be output.
		1	Card input sequence will be output but not input variable values.
		2	Card input sequence and input variable value listings will not be output.
2	IPRINT		Job printout specifications may be overridden by variable IPRNT (DR.5) for each reach.
		0	Print crop budget, duration loss, crop area flooded, and damage tables for zones, seasons, events, and reach.
		1	Print crop damage and area flooded tables by zone, season, event, and reach.
		2	Print crop damage table for season, event, and reach.
		3	Print crop damage tables for event, and reach.
3	PINDEX	+	Price index factor, to be multiplied by all damage values. Used to expediently update economic values.
4	INFRAS	0	Infrastructure damages will not be analyzed in this program execution.
		+	Infrastructure damage factor taken as a percent of the damage to crops. Represents damage to roads, tile drains, culverts, etc., associated with agricultural cropping business.

J1

5	MULTFD	0	No adjustment will be made to calculated damage values to account for multiflood replant considerations. Adjustments may be made on individual crop basis by MULTFL (CR.6).
		+	Percent adjustment (multiplier) to be taken times the calculated crop damage values to account for multiflood replant considerations. For example, a value of 1.5 would increase all calculated damage values for the job by 50 percent. Adjustments will be made for all associated job damage values unless overridden by MULTFL (CR.6) for an individual crop.
6	DSSOUT	0	Data will not be retrieved or output to DSS during this run. ZN, ZR, ZC, and ZH cards are not used.
		1	Data will be retrieved or output to DSS during this run. A ZN card is required.
7	CRFILE	0	Crops values and loss potential data (CR, CT, CB, CD, C1-C6 cards) will be read from cards.
		1	Crop value and loss potential data (CR, CT, CB, CD, C1-C6 cards) will be read from cards and written to file 10 for future use.
		2	Crop value and loss potential data (CR, CT, CB, CD, C1-C6 cards) will be read from file 10 which was written in a previous run. CR, CT, CB, CD, C1-C6 cards are omitted from this run.

APPENDIX F
INPUT DESCRIPTION

3.2 ZN CARD - DSS PATHNAME LABELS

The optional ZN card designates the use of the HEC Data Storage System (DSS) in the job and is required when variable DSSOUT (J1.6) equals 1. The ZN card also provides essential parts of the pathname needed for automatic transfer of data from AGDAM to the DSS. See Appendix D, for further explanation of the DSS file. The ZN card provides the DSS pathname for the run. All or portions of the pathname may be overridden on ZR, ZC, and ZH cards.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	ZN	Card identification.
1-2	PROJ	AN	Alphanumeric project pathname label. This is part A of the file pathname to be used to send data to the DSS. The input pathname begins with the first non-blank character in the field and includes the remainder of the two fields.
3-4	REACH	AN	Pathname part B used for reach identification of data to be sent to DSS. Normally, the damage reach label.
5-6	IDATE	AN	Alphanumeric pathname label for the beginning date of the hydrograph. Part D of the pathname. Labels are normally input on ZH cards and blank on ZN card.
7-8	IYEAR	AN	Alphanumeric pathname label for a year value. Part E of pathname. Normally used to identify year of plan, for example 1990, 2000, etc.
9-10	IPLAN	AN	Alphanumeric pathname label for the alternative or plan. Part F of the pathname.

4.0 JOB CROP DAMAGE CARDS - CR CARDS

The required CR cards specify crop data used for the entire job. The CR cards specify the crop yield, price and potential damage (loss) based on duration of flooding and season. A set of CR through C6 cards is required for each crop.

APPENDIX F
INPUT DESCRIPTION

CR CARDS - REQUIRED

4.1 CR CARD - CROP DATA

The required CR card specifies the type of crop, unit price, and yield.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	CR	Card identification.
1	CRPTIT	AN	Crop title (corn, wheat, etc.)
2	CYA	+	Yield per unit area (acre) of crop (in tons, bushels, pounds, etc.). The value is multiplied by variable CUP (CR.4) to obtain the value per unit area (acre) at harvest.
3	CUNITS	AN	Crop units associated with yield per (acre), variable CYA (CR.2), i.e., bushels, tons, pounds, etc.
4	CUP	+	Unit price of crop (dollars per bushel, ton, etc.).
5	MULTFL	0	Job multiflood adjustment factor, variable MULTFD (J1.5) will be used.
		+	Adjustment (multiplier) to crop damage values to account for multiflood and replant considerations. Overrides job adjustment factor MULTFD (J1.5).
6	ICULT	+	Julian day of year (e.g., 59 is used for February 28) associated with end of cultivation period. Value used for output information purposes only.
7	IMATUR	+	Julian day of year when crop reaches maturity (greatest damage potential). Value used for output information purposes only.
8	IHRVST	+	Julian day of year when harvest begins. Values used for information purposes only.
9	HRVCST	+	Harvest cost in dollars per acre.

APPENDIX F
INPUT DESCRIPTION

4.2 CT CARD - JULIAN DAYS OF YEAR

The required CT card specifies the Julian day of the calendar year corresponding to the crop loss and duration loss adjustments on the CB and C1-C6 cards, respectively. Leap years are not considered. A maximum of 30 individual days may be input to define the crop loss and duration data.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	CT	Card identification.
1	CDAY(1)	+	Calendar day of year associated with first field values on the CB and C1-C6 cards. (Examples are January 15 input as 15, March 1, input as 31+28+1 or 60).
2	CDAY(2)	+	Calendar day associated with second field values on CB and C1-C6 cards.
N	CDAY(N)	+	Calendar day associated with N-field values on CB and C1-C6 cards. A maximum of 30 values may be input. The eleventh value is input on first field of second CT card.

4.3 CB CARD - CROP LOSS FUNCTION

The required CB card defines the crop loss function. Potential crop loss values are input as percentages associated with the Julian calendar days input on the CT card.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	CB	Card identification
1	BUDGET(1)	+	Percent loss associated with day of calendar year CDAY1 (CT.1).
2	BUDGET(2)	+	Percent loss associated with day of calendar year CDAY2 (CT.2).
N	BUDGET(N)	+	Percent loss associated with day of calendar year CDAYN (CT.N).

APPEDIX F
INPUT DESCRIPTION

4.4 CD CARD - DURATION VALUES

The required CD card specifies duration of flooding values. The values are flood duration in days associated with the percent damage values input on C1-C6 cards. The titles are used in output tables.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	CD	Card identification.
1	DUR(1)	+	Flood duration value in days associated with percent loss values input on C1 cards. Normally input as 0 (zero days).
2	DUR(2)	+	Flood duration value in days associated with percent loss values input on C2 cards.
N	DUR(3)	+	Same as above for up to six sets of values. Typical durations may be 3 days, 7 days, 14 days, etc.

4.5 C1-C6 CARDS - PERCENT LOSS FROM FLOOD DURATION

The C1 through C6 cards specify the percent crop loss due to the duration of flooding. The C1 cards correspond to duration values of DUR(1) (CD.1); the C2 card DUR(2) (CD.2), etc.

4.5.1 C1 CARD - DURATION LOSS VALUES

This card specifies the percent crop loss values due to duration of flooding. Each value corresponds to an input Julian calendar day of the year on the CT card. The values correspond to the duration specified by variable DUR(1) (CD.1). Values on C1 card typically refer to zero days of flooding (loss potential normally would be zero).

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	C1	Card identification.
1	PCTDAM(1,1)	+	Percent loss of crop corresponding to duration of flooding specified by DUR(1) (CD.1), and day of calendar year CDAY1 (CT.1).

APPENDIX F
INPUT DESCRIPTION

C1 CARD (Cont'd)

FIELD	VARIABLE	VALUE	DESCRIPTION
2	PCTDAM(2,1)	+	Percent loss of crop corresponding to duration of flooding specified by DUR(1) (CD.1) and day of calendar year CDAY(2) (CT.2).
N	PCTDAM(N,1)	+	Same as above for each day of calendar year input on CT card.

4.5.2 C2 CARD

The C2 card specifies percent crop loss values associated with variable DUR(2) (CD.2) and each day of calendar year input on CD cards.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	C2	Card identification.
1	PCTDAM(1,2)	+	Percent loss of crop corresponding to duration of flooding specified by DUR(2) (CD.2), and day of calendar year CDAY(1) (CT.1).
2	PCTDAM (2,2)	+	Percent loss of crop corresponding to duration of flooding specified by DUR(2) (CD.2), and day of calendar year CDAY(2) (CT.2).
N	PCTDAM(N,2)	+	Same as above for duration title and each day of calendar year.

C3-C6 CARDS

These cards continue the percent damage by duration input for each duration specified on the CD card and day of the calendar year specified on the CT card.

5.0 SEASON ANALYSIS CARDS

The required season cards (SN and SD) define the seasons of the year to be used in the agricultural flood damage analysis. The specified seasons are used for the entire job. The number and dates of the seasons should be determined from economic damage and hydrologic considerations.

APPENDIX F
INPUT DESCRIPTION

5.1 SN CARD - SEASON TITLES

The required SN Card specifies the number of seasons to be used in the crop damage analysis. A maximum of 12 seasons may be defined.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	SN	Card identification.
1-2	SNTIT(1)	AN	Alphanumeric title of first season in columns 3 to 16 to be used in output tables. For example, title might be 1 Jan to 1 May, or simply Winter, Spring, Summer or Fall.
3-4	SNTIT(2)	AN	Alphanumeric title of second season as described above.
N	SNTIT(N)	AN	Same as above for up to nine seasons. The sixth season is placed in fields 1-2 of the second SN card. If last season (say winter) is same as first season of year, the last title must be exactly the same as first title.

5.2 SD CARD - SEASONAL DAYS DEFINITION

The required SD card specifies the initial Julian day of the season to be analyzed. The values are used to determine the starting and ending days of each season.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	SD	Card identification.
1	SNDAY(1)	+	Julian calendar day associated with the first day of season SNTIT(1) (SN.1-2). A value of one (1) would be input for 1 January, and 58 for 28 February.
2	SNDAY(2)	+	Julian calendar day associated with the first day of the second season SNTIT(2) (SN.3-4).
N	SNDAY(N)	+	Same as above for 12 seasons.
N+1	SNDAY(N+1)	+	Date of last day of N season. Assumed to be 365 if blank.

APPENDIX F
INPUT DESCRIPTION

6.0 JOB EXCEEDANCE FREQUENCY ASSIGNMENT CARDS

The required job exceedance frequency cards (FT and FR) specify title and corresponding exceedance frequency values desired for output tables for the entire job, respectively. Hydrographs input on H1 through H9 cards are interpolated based on input (actual) frequency values on the HF cards to be consistent with desired job frequencies on the FR card.

6.1 FT CARD - FREQUENCY TITLE CARD

The required FT card specifies the frequency title associated with each hydrograph event to be analyzed for this job. The event frequency must be input in increasing order with respect to magnitude; such as, 5-year, 10-year, 25-year, and 100-year event. Values on FT card are used only for labeling of tables, not for analysis. Up to 9 events may be defined.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	FT	Card identification.
1	FRTIT(1)	AN	Frequency title of first (most frequent) hydrograph to be analyzed. Example, 2-year; 5-year, etc.
2	FRTIT(2)	AN	Frequency title of second hydrograph to be analyzed.
N	FRTIT(N)	AN	Frequency title of largest (rarest frequency) hydrograph to be analyzed.

APPENDIX F
INPUT DESCRIPTION

6.2 FR CARD - EVENT FREQUENCY ASSIGNMENTS

The required FR card specifies the % chance exceedance frequency associated with each event for the job. Values are input in increasing order with respect to the magnitude of the event: 50, 25, 10, 2, 1, etc. These values provide consistent frequency assignments between seasonal sets of hydrographs and with respect to damage reaches.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	FR	Card identification.
1	FREQ(1)	+	Exceedance frequency of first (most frequent) hydrograph to be analyzed. Example: 50 for 2-year event, 20 for 5-year event, etc. Must correspond to FRTIT(1) (FT.1).
2	FREQ(2)	+	Exceedance frequency of second frequency hydrograph to be analyzed. Must correspond to FRTIT(2) (FT.2).
N	FREQ(N)	+	Same as above for up to 9 events.

6.3 P1-P9 CARDS - EVENT SEASONAL WEIGHTINGS

The P1 through P9 cards specify the proportion of time flood events designated on the FR card occur in the seasons designated on the SN card.

APPENDIX F
INPUT DESCRIPTION

6.3.1 P1 CARD - EVENT ONE SEASONAL WEIGHTINGS

The required P1 card specifies the proportion of time event one, FRTIT(1) (FT.1), occurs in each of the seasons designated on the SN card. For example, given that the event (FT.1) occurs, input the proportion of time it occurs in each of the seasons.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	P1	Card identification.
1	PROB(1,1)	+	Proportion of time (20 percent input as 20) of frequency flood FRTIT(1) (FT.1) occurs in season SNTIT(1) (SN.1).
2	PROB(2,1)	+	Proportion of time frequency flood FRTIT (1) (FT.1) occurs in season SNTIT (2) (SN.2).
N	PROB(N,1)	+	Same as above for frequency event one for up to 12 seasons.

6.3.2 P2 CARD - EVENT TWO SEASONAL WEIGHTINGS

The P2 card specifies the proportion of time event two, FRTIT(2), FT.2 occurs in each season defined on the SN card .

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	P2	Card identification.
1	PROB(1,2)	+	Proportion of time (20 percent input as 20) of frequency flood FRTIT(2) (FT.2) occurs in season SNTIT(1) (SN.1).
2	PROB(2,2)	+	Proportion of time of frequency flood FRTIT(2)(FT.2) occurs in season SNTIT(2)(SN.2).
N	PROB(N,2)	+	Same as above for frequency event two for up to 12 seasons.

6.3.3 P3-P9 CARDS - EVENT 3-9 SEASONAL WEIGHTINGS

These cards continue input in the same manner as the P1 and P2 cards as needed for each frequency event.

APPENDIX F
INPUT DESCRIPTION

7.0 DAMAGE REACH CARDS

The damage reach data cards include DR, DT, EV, QQ, ZR, EL, AR, CP, CA, and ZC cards. A set of damage reach cards are required for each reach analyzed. They specify the damage reach data and title, elevation-discharge relationships, elevation-area relationships, and crop categories and distribution percentages.

7.1 DR CARD - DAMAGE REACH SPECIFICATIONS

The required DR card is used to define damage reach specifications and subsequent card input requirements for the reach.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	DR	Card identification.
1	DRID	AN	Alphanumeric identification of this damage reach. Used as reach identifier for DSS pathname.
2	ELAREA	0	Elevation-area values for the total agricultural crop area will be input on EL, and AR cards. CP cards will be input to define crop distribution of area.
		1	Elevation-area values unique to each crop will be input on EL, CP, and CA cards.
		2	Elevation-area values for the total agricultural crop area will be input from HECDSS data files. ZC and CP cards are required. EL and AR cards are omitted.
		3	Elevation-area values of individual crops will be input from DSS. The ZC and CP cards are required.
3	RATE	0	Rating curve values will be input on EV (elevation) and QQ (discharge) cards for the reach. Hydrographs are discharge-time series.
		1	Rating curve not required. Hydrographs are entered as elevation (stage)-time series rather than discharge-time series.

APPENDIX F
INPUT DESCRIPTION

DR CARD (Cont'd)

FIELD	VARIABLE	VALUE	DESCRIPTION
		2	Rating curve (discharge-elevation relationships) for this reach is read from DSS file.
4	IPRNT		This variable specifies the output print control for this reach. Overrides IPRINT (J1.2) for this reach only.
		0	Output as specified by IPRINT (J1.2).
		1	Print crop damage and area flooded tables by zone, season, event and reach.
		2	Print crop damage and area flooded tables by season, event and reach.
		3	Print crop damage and area flooded tables by event and reach.
5	ZDFREQ	+,0	Exceedance frequency at start of damage (zero damage). Used in expected annual damage computations. If blank, calculations truncate frequency function after most frequent event (if greater than zero damage).
6	AGAREA	AN	DSS agricultural area category name. Used to retrieve total agricultural area-elevation function from DSS (DR.2=2).

7.2 DT CARD

The required DT card specifies the title to be output for the reach.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	DT	Card identification.
1-10	DRTIT	AN	Alphanumeric title for each.

APPENDIX F
INPUT DESCRIPTION

7.3 EV CARD - ELEVATION VALUES FOR REACH RATING CURVE

The EV card is required if variable RATE (DR.3) equals zero. The EV card specifies the elevation values associated with the input of a discharge-elevation rating curve for the damage reach index location. The corresponding discharge values are input on the following QQ card. Values are input in increasing order.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	EV	Card identification.
1	EV(1)	+	First elevation value for defining discharge-elevation rating curve. Corresponds to first discharge values on the following QQ card.
2	EV(2)	+	Second elevation value of rating curve. Corresponds to second discharge value on the following QQ card.
N	EV(N)	+	Same as above for up to 18 values.

7.4 QQ CARD - DISCHARGE VALUES FOR REACH RATING CURVE

The QQ card is required if variable RATE (DR.3) equals zero. The QQ card specifies the discharge values associated with the input of a discharge-elevation rating curve for the damage reach index location. The corresponding elevation values are input on previous EV cards. Values are input in increasing order. Ordinate units (cfs or m^3/sec) must be consistent with those of the hydrograph.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	QQ	Card identification.
1	Q(1)	+	First discharge value, normally zero, used in defining the discharge-elevation rating curve. Corresponds to first elevation value on initial EV card.
2	Q(2)	+	Second discharge value corresponding to second elevation value on the EV card.
N	Q(N)		Same as above for up to 18 values.

APPENDIX F
INPUT DESCRIPTION

7.5 ZR CARD - RATING CURVE FROM DSS

The optional ZR card defines the pathname used to retrieve discharge-elevation (rating curve) values from the DSS. The ZR card is required following the DT card for the reach when variable RATE (DR.3) equals 2. The EL and QQ cards are omitted. The fields may be blank if pathname parts are exactly those on ZN card.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	ZR	Card identification.
1-2	PROJ(J)	AN	Alphanumeric project pathname label corresponding to part A of the pathname. Must exactly match the project name in DSS. May be blank if same as project name on ZN card.
3-4	REACH(J)	AN	Pathname part B used for reach identification of rating curve data to be retrieved from DSS. If blank, the reach title DRID (DR.1) is used.
5-6	IDATE(J)	AN	Not used. Part D of pathname.
7-8	IYEAR(J)	AN	Alphanumeric pathname label for a year value. Part E of pathname (see ZN card).
9-10	IPLAN(J)	AN	Alphanumeric pathname label for the alternative or plan. Part F of the pathname (see ZN card).

APPENDIX F
INPUT DESCRIPTION

7.6 EL CARDS - ELEVATION VALUES FOR AREA-ELEVATION DATA

The EL card is required if ELAREA (DR.2) equals 0 or 1. Elevation values are input corresponding to area values on AR or CA cards. The values also define the flood zones used in the damage calculations. A maximum of 18 values may be input.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	EL	Card identification.
1	EL(1)	+	First elevation value, generally associated with a zero crop area.
2	EL(2)	+	Second elevation value.
N	EL(N)	+	Last elevation value. Eleventh value is input in first field of second EL card.

7.7 AR CARD - TOTAL CROP AREA VALUES

The optional AR card is required if ELAREA (DR.2) equals 0. The card specifies total cumulative crop area for the reach. Values must correspond to elevation values input on EL card.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	AR	Card identification.
1	AREA(1)	+	Initial area value in acres (hectares), usually zero, that corresponds to EL(1) on the EL card.
2	AREA (2)	+	Second area value in acres corresponding to EL(2) on the EL card.
N	AREA (N)	+	Last area value in acres. Eleventh value is input in second field of second AR card.

APPENDIX F
INPUT DESCRIPTION

7.8 CP CARD - CROP DATA FOR REACH

A CP card is required for each crop to be analyzed for the damage reach. The card is used to define crop distributions and double cropping patterns.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	CP	Card identification.
1	CROPT	AN	Crop identification. Must be exactly the same as variable CRPTIT (CR.2) unless IDC (CP.4) is one.
2	PRCT	0	Area distribution values for this crop corresponding to elevation values on the EL card will be input on following CA cards. If double cropped, entire double cropped area must be input.
		+	Percent of this crop of the total agricultural area of the reach as defined on the EL (elevation) and AR (area) cards. If double cropped, entire double cropped area must be input.
3	IDC	0	The area of this crop is single cropped.
		1	The area of this crop is double cropped.
4	DCROP1	AN	Crop identification for first of two crops that are double cropped for this area. Must exactly match title on a CR card, variable CRPTIT (CR.2). Omit if variable IDC (CP.4) is zero.
5	DCROP2	AN	Crop identification for second of two crops that are double cropped for this area. Must exactly match title on a CR card, variable CRPTIT (CR.2). Omit if variable IDC (CP.4) is zero.

APPENDIX F
INPUT DESCRIPTION

7.09 CA CARD - INDIVIDUAL CROP AREA VALUES

The optional CA card specifies the area associated with the crop defined on the previous CP card, variable CROPT (CP.2). The input area values must correspond to the elevation values input on the EL card.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	CA	Card identification.
1	CAREA(1)	+	Area value in acres associated with initial elevation value ELEV(1) on the EL card. First value must be zero.
2	CAREA(2)	+	Area value in acres associated with second elevation value ELEV(2) on the EL card.
N	CAREA(N)	+	Same as above for up to 18 values.

APPENDIX F
INPUT DESCRIPTION

7.10 ZC CARD - CROP AREA-ELEVATION

The optional ZC card defines the pathname used to retrieve crop area-elevation data from the DSS. The ZC card follows the set of CP cards. When the elevation-total agricultural crop area relationship is retrieved from the DSS (ELAREA (DR.2) equals 2), the EL and AR cards are omitted. When the individual elevation-crop area relationships are retrieved from the DSS (ELAREA (DR.2) equals 3), the variable CROPT (CP.1) is the damage category label, part C of the pathname. Variable CROPT must be exactly that of the category label to be retrieved from the DSS.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	ZC	Card identification.
1-2	PROJ(K)	AN	Alphanumeric project pathname label. This is part A of the file pathname to be used to retrieve crop area-elevation data from the DSS. The input name begins with the first no-blank character in the field and includes the remainder of the two fields.
3-4	REACH(K)	AN	Pathname part B used for reach identification of crop area-elevation data to be retrieved from DSS. May be omitted if exactly reach label used on ZN card.
5-6	IDATE(K)	AN	Blank for ZC card. Part D of pathname.
7-8	IYEAR(K)	AN	Alphanumeric pathname label for a year value, part E of pathname.
9-10	IPLAN(K)	AN	Alphanumeric pathname label for the alternative or plan. Part F of the pathname.

APPENDIX F
INPUT DESCRIPTION

8.0 HYDROLOGIC DATA CARDS

Hydrologic data cards (QD, HQ, HF, and H1-H9) define events used in the analysis. A series of hydrologic data cards is required for each damage reach and for each season that has unique hydrologic runoff characteristics that effect flood damage calculation. The QD card specifies the type and method of input for the hydrograph. The HQ card specifies the seasons (SN card) associated with set of hydrographs. The HF card specifies the exceedance frequency values associated with the input hydrographs. The H1 through H9 cards are input hydrograph ordinate values.

8.1 QD CARD - REACH HYDROLOGIC DATA SPECIFICATIONS

A QD card is required for each damage reach. It specifies the nature of the hydrograph data, number of ordinate values, time interval, and method of input.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	QD	Card identification.
1	DRID	AN	Alphanumeric damage reach label for this set of hydrologic data. Must equal DRID (DR.1).
2	HYDRO	0	Hydrographs are discharge-time based. A rating curve, EV and QQ cards, must be included by this reach.
		1	Hydrographs are elevation (stage)-time based.
3	NORD	+	Number of ordinates to be read on H cards for each hydrograph. Also number of ordinates if data are read from DSS.
4	TINC	+	Time interval in minutes of hydrograph ordinate data. Example, two hours equals input of 120.
5	HPRNT	0	Hydrograph ordinate values for this reach will not be output.
		1	Hydrograph ordinate values for this reach will be output.
6	DSSH	0	Hydrograph ordinates are read on H1-H9 cards.
		1	Hydrograph ordinates are read from DSS file. A ZH card is required for each set of hydrographs.

APPENDIX F
INPUT DESCRIPTION

8.2 HQ CARD - HYDROGRAPH SEASONS

The required HQ card specifies the seasons each set of hydrographs correspond to in the analysis. Season names must be input in natural order, with identical titles as input on the SN cards. If one set of hydrographs is to apply for all seasons of the year the HQ card must be blank. An HQ card(s) must precede each seasonal set of H1-H9 cards or ZH card.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	HQ	Card identification.
1-2	SEASN(1)	AN	Alphanumeric title of first season of the year to which the following set of balanced frequency hydrographs will be applied. Must be identical to seasonal title on the SN card.
3-4	SEASN(2)	AN	Alphanumeric title of second season of the year to which the following set of frequency hydrographs will be applied. Must naturally follow previous season (spring follows winter, etc.) in the year.
N-N+1	SEASN(N)	AN	Same as above for up to 9 seasons. The fifth season is placed in fields 1-2 of the second HQ card.

APPENDIX F
INPUT DESCRIPTION

8.3 HF CARD - INPUT HYDROGRAPHS EXCEEDANCE FREQUENCY ASSIGNMENTS

The HF card must follow each HQ card and precede each set of H1-H9 cards. The HF card is omitted when a ZH card is used. The values specified on the HF card are percent exceedance frequency assignments associated with the input hydrographs on the H1 through H9 cards. If a blank HF card is input frequency assignments are assumed the same as the job exceedance frequency values input on the FR card. A blank HF card requires a hydrograph input for each frequency value specified on the FR card.

If exceedance frequency values are input on the HF card the hydrograph ordinate values are interpolated to correspond to job frequency assigments specified on FR card. HF values are input in decreasing order (50, 20, 10, 2, etc.). A maximum of nine values may be input. The last value must be less than or equal to the last value on the FR card.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	HF	Card identification.
1	HFREQ(1)	+	Exceedance frequency value for hydrograph input on H1 cards.
2	HFREQ(2)	+	Exceedance frequency value for hydrograph input on H2 cards.
N	HFREQ(N)	+	Same as above for up to 9 exceedance frequency values.

8.4 H1-H9 CARDS - HYDROGRAPH ORDINATE VALUES

The H1 through H9 cards are used to input flood hydrograph ordinate (discharge or stage) values. Hydrograph ordinate values corresponding to FREQ(1) (FR.1) for seasons input on HQ card are input on H1 cards, FREQ(2) (FR.2) on H2 cards, continuing as needed through the H9 card.

APPENDIX F
INPUT DESCRIPTION

8.4.1 H1 CARDS - HYDROGRAPH ONE ORDINATE VALUES

The H1 cards are required if DSSH (QD.5) is equal to zero. If DSSH equals 1 these data are read from DSS and H1-H9 cards are omitted. Maximum of 150 ordinate values per hydrograph.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	H1	Card identification.
1	ORD(1)	+	First ordinate of FREQ(1) frequency hydrograph for seasons specified on HQ card. Ordinates are discharge values if HYDORD (QD.2) equals zero, and elevation values if HYDORD (QD.2) is greater than zero.
2	ORD(2)	+	Second ordinate of FREQ(1) (FQ.1) frequency hydrograph.
N	ORD(N)	+	Same as above, 10 ordinates per card, for NORD (QD.3) number of ordinates.

8.4.2 H2 CARD - HYDROGRAPH TWO ORDINATE VALUES

The H2 cards are required if DSSH (QD.5) is equal to zero. If DSSH is greater than zero these data are read from DSS.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	H2	Card identification.
1	ORD(1)	+	First ordinate of FREQ(2) (FQ.2) frequency hydrograph for seasons specified on HQ card. Ordinates are discharge values of HYDROD (QD.2) equals zero and elevation values if HYDROD (QD.2) is greater than 1.
2	ORD(2)	+	Second ordinate of FREQ(2) (FQ.2) frequency hydrograph.
N	ORD(N)	+	Same as above, 10 ordinates per card, for NORD (QD.3) number of ordinates.

8.4.3 H3-H9 CARDS - HYDROGRAPH ORDINATE VALUES

These cards continue with input in the same manner as the H1 and H9 cards.

APPENDIX F
INPUT DESCRIPTION

8.5 ZH CARD

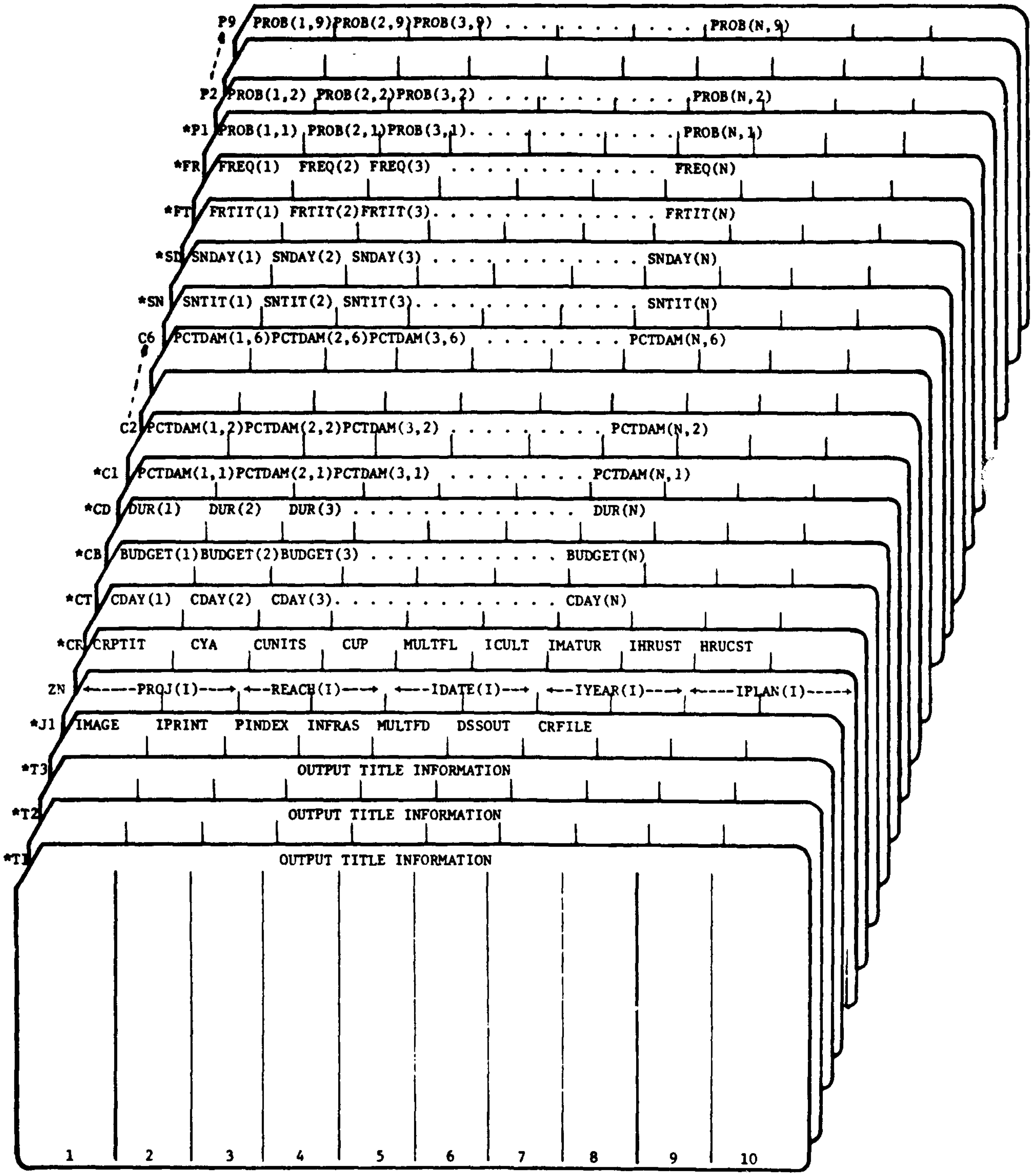
The optional ZH card defines the pathname used to retrieve seasonal sets of hydrograph frequency assignments and ordinate values from the DSS. The ZH card is required if DSSH (QD.6) equals one. The HF and H1-H9 cards must be omitted if ZH cards are used. The pathname parts may be left blank if those input on the ZN card are to be used. Otherwise the pathname parts will override the ZN card values.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	ZH	Card identification
1-2	PROJ(M)	AN	Alphanumeric project pathname label corresponding to part A of the pathname. Must be exactly that of project name assignment of desired data in DSS. May be blank if same as project name on PN card.
3-4	REACH(M)	AN	Pathname part B used for reach identification of hydrograph data in DSS. If blank, DRID (DR.1) is used.
5-6	IDATE(M)	AN	Alphanumeric pathname label for beginning date of hydrograph. Part D of pathname. If used, overrides value on ZN card.
7-8	IYEAR(M)	AN	Alphanumeric pathname label for a year value, part E of pathname. May be blank if same as year label on ZN card.
9-10	PLAN(M)	AN	Pathname part F used for alternatives (existing, 1990, Plan 2, etc.) identification. Must be exactly that of plan identification of desired hydrologic data in DSS.

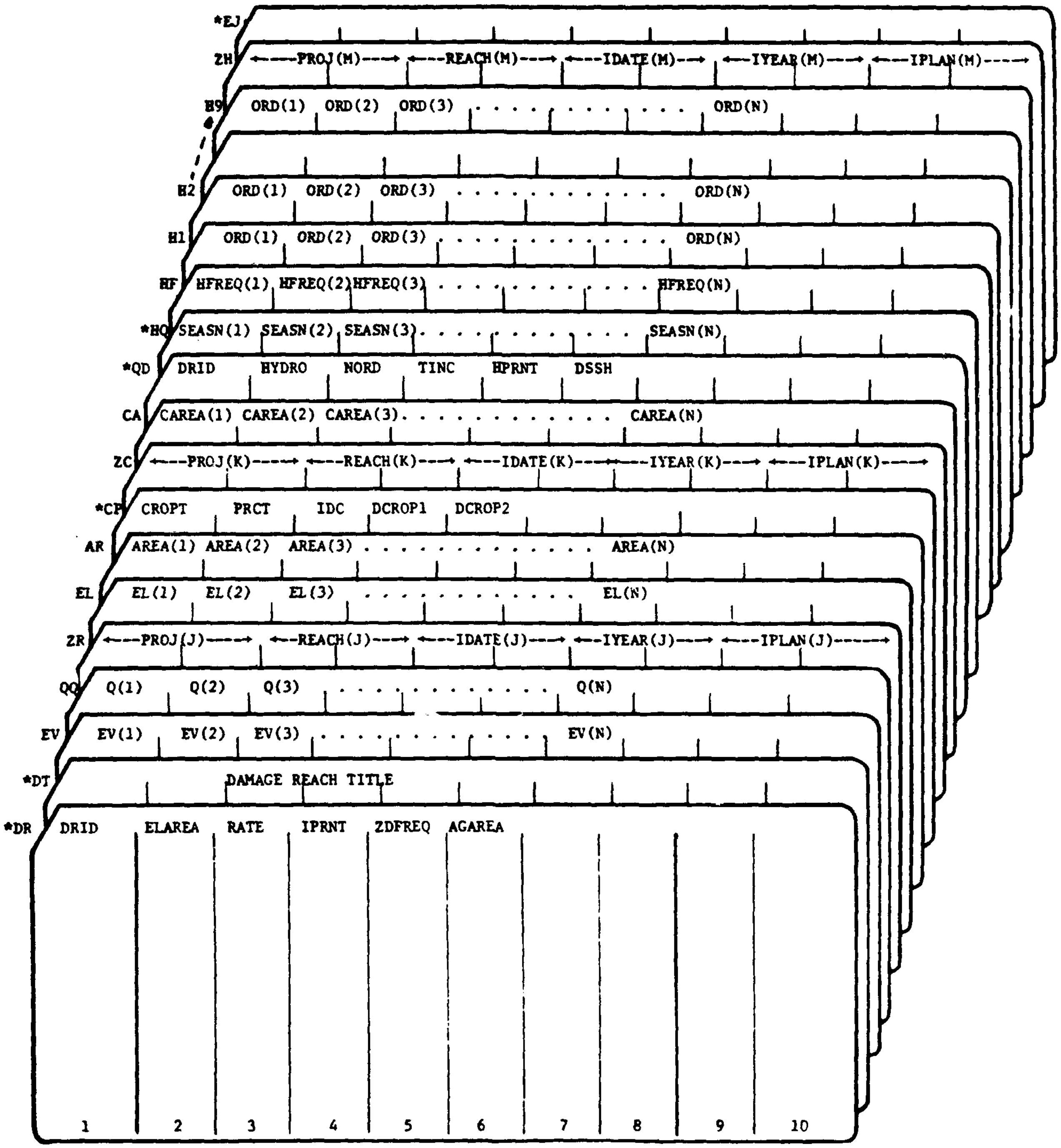
9.0 EJ CARD - END OF JOB

The required EJ card is used at the end of the input data stream to designate the end of job.

FIELD	VARIABLE	VALUE	DESCRIPTION
0	KODE	EJ	Card identification.



* Required cards. Remaining cards are optional and depend upon desired program options and input data.


*EJ
ZH PROJ(M) REACH(M) IDATE(M) IYEAR(M) IPLAN(M)
H9 ORD(1) ORD(2) ORD(3) . . . . ORD(N)
H2 ORD(1) ORD(2) ORD(3) . . . . ORD(N)
H1 ORD(1) ORD(2) ORD(3) . . . . ORD(N)
HF HFREQ(1) HFREQ(2) HFREQ(3) . . . . HFREQ(N)
*HQ SEASN(1) SEASN(2) SEASN(3) . . . . SEASN(N)
*QD DRID HYDRO NORD TINC HPRNT DSSH
CA CAREA(1) CAREA(2) CAREA(3) . . . . CAREA(N)
ZC PROJ(K) REACH(K) IDATE(K) IYEAR(K) IPLAN(K)
*CP CROPT PRCT IDC DCROP1 DCROP2
AR AREA(1) AREA(2) AREA(3) . . . . AREA(N)
EL EL(1) EL(2) EL(3) . . . . EL(N)
ZR PROJ(J) REACH(J) IDATE(J) IYEAR(J) IPLAN(J)
QQ Q(1) Q(2) Q(3) . . . . Q(N)
EV EV(1) EV(2) EV(3) . . . . EV(N)
*DT DAMAGE REACH TITLE
*DR DRID ELAREA RATE IPRNT ZDFREQ AGAREA
1 2 3 4 5 6 7 8 9 10

2